

PROPOSED MEMBERSHIP FOR THE FORT WAINWRIGHT TRC (CONT.)

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Appendix G
TECHNICAL ASSISTANCE GRANT INFORMATION

TECHNICAL ASSISTANCE GRANT INFORMATION

Basic Provisions and Uses

The following is a list of the basic provisions of the TAG Program:

- Grants up to \$50,000 are available to community groups for the purpose of hiring technical advisors to make site-related technical information understandable;
- The community group applying for a grant must cover 20% of the total costs of the project to be supported by TAG funds;
- The community group must budget the expenditure of grant funds to cover the entire cleanup period (which average six years);
- The group must become incorporated once it is awarded a TAG; and
- Only one TAG may be awarded per NPL site, but, under certain conditions, it may be renewed.

Some examples of acceptable uses of TAG funds are listed below:

- Technical advisor review of site-related documents;
- Meetings between the technical advisor and the community group to explain technical information;
- Professional assistance by the technical advisor to communicate site-related concerns to the community;
- Dissemination of interpretations of technical information by the technical advisor to the community; and
- The technical advisor's participation in site visits, when possible, to gain a better understanding of cleanup activities.

Application Eligibility and Requirements

Groups eligible to receive grants under the TAG program are those whose membership may be affected by a release or threatened release of hazardous wastes at any facility listed on the NPL. In general, eligible groups are groups who live near the site and whose health, economic well-being, or enjoyment of the environment are directly threatened. Any group applying for a TAG must be nonprofit and incorporated or working towards incorporation under applicable state laws. Applications are encouraged from:

- Groups who have a genuine interest in learning more about the technical aspects of a nearby hazardous waste site; and

TECHNICAL ASSISTANCE GRANT INFORMATION (CONT.)

- Groups who have, or intend to establish, an organization to manage a grant efficiently and effectively.

Groups who may fall into this category include existing citizens' associations, environmental or health advocacy groups, or coalitions of such groups formed to deal with community concerns about the hazardous waste site and its impact on the surrounding area.

Groups who are not eligible for grant funds are:

- Potentially responsible parties: any individuals or companies (e.g., facility owners/operators or hazardous waste generators/transporters) potentially responsible for or contributing to the contamination problems at a Superfund site;
- Academic institutions;
- Political subdivisions; and
- Groups established and/or sustained by government entities (including emergency planning committees and some citizen advisory groups).

When applying for a TAG, a group must provide information to EPA to determine if the group meets specific administrative and managerial requirements. The application also must include a description of the group's history, goals, and plans for using the technical assistance funds. Factors that are particularly important in this evaluation process include:

- The group's ability to manage the grant in compliance with EPA grant and procurement regulations;
- The degree to which the group members' health, economic well-being, and enjoyment of the environment are adversely affected by a hazardous waste site;
- The group's commitment and ability to share the information provided by the technical advisor with others in the community;
- Broad representation of affected groups and individuals in the community; and
- Whether the applicant group is incorporated. (Only incorporated groups may receive grants. Groups must either be incorporated specifically for the purpose of addressing site-related problems or incorporated for broader purposes if the group has a substantial history of involvement at the site.)

Notification Procedures and Evaluation Criteria

To ensure that all eligible groups have equal access to technical assistance and an equal opportunity to compete for a single available grant (if a coalition of groups proves to be impossible), EPA has established a formal notification process, which includes the following steps:

- Groups wishing to apply for a TAG must first submit to EPA a short letter stating their group's desire to apply and naming the site(s) involved;

TECHNICAL ASSISTANCE GRANT INFORMATION (CONT.)

- Other potential applicants then would have 30 days to contact the original applicant to form a coalition;
- If potential applicants are unable to form a coalition, they will notify EPA within this time period and EPA will accept separate applications from all interested groups for an additional 30-day period; and
- EPA will award a grant to the applicant that best meets the requirements described above.

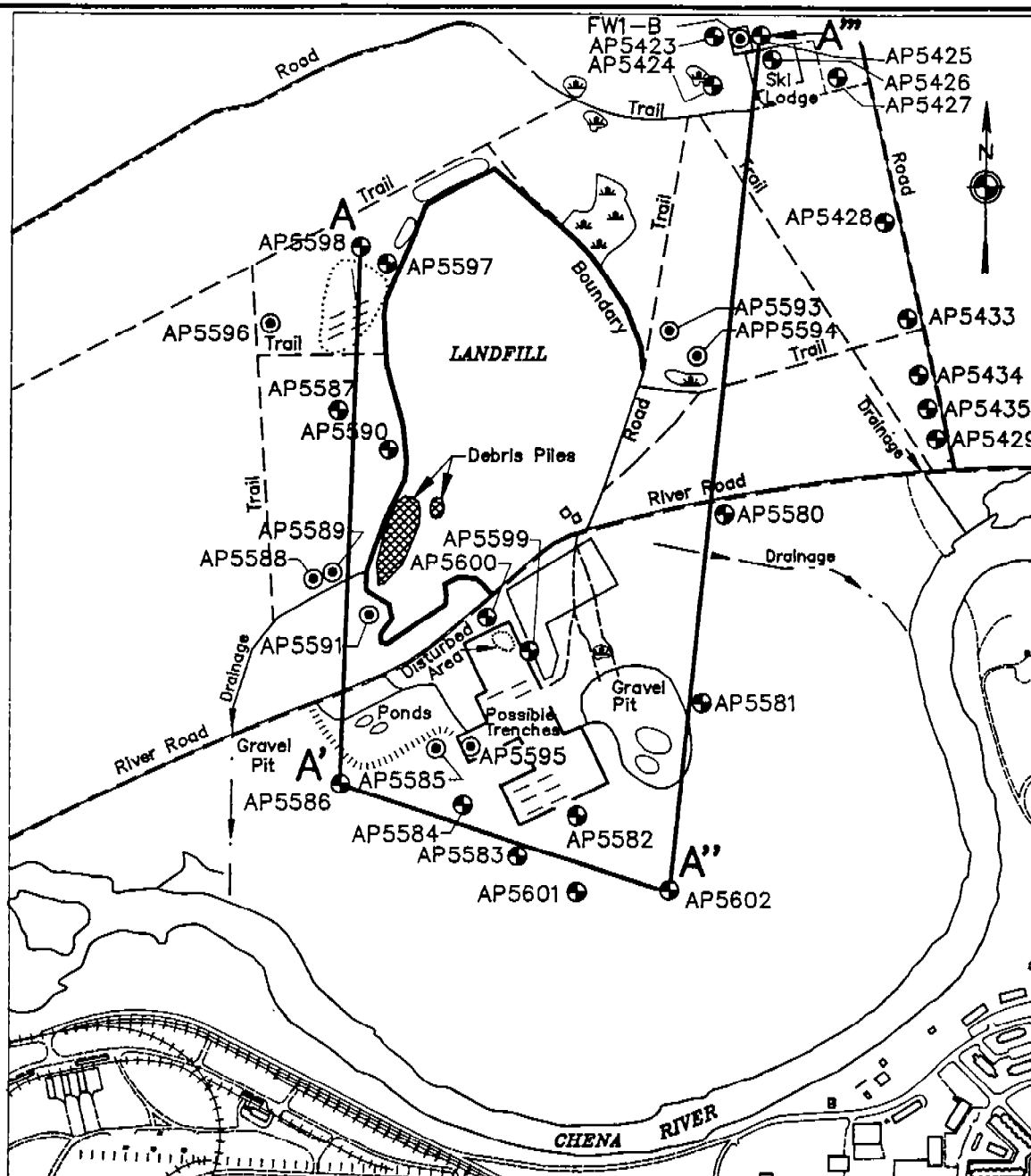
The maximum grant that can be awarded to any group is \$50,000. The actual amount depends on what the group intends to accomplish. A group's minimum contribution of 20% of the total costs of the technical assistance project can be made in cash and/or "in-kind" contributions, such as office supplies or services by the group. These services might include, for example, publication of a newsletter or the time an accountant donates to managing the group's finances. The value of donated professional services is determined based on rates charged for similar work in the area.

In special cases where an applicant group intends to apply for a single grant covering multiple sites in proximity to each other, EPA can allow a deviation from the \$50,000 grant limit. In such cases, however, the recipient cannot receive more than \$50,000 for each site to which it intends to apply funds.

Additional Information

For further information on the application process or any other aspect of the TAG program, please contact the EPA Region 10 Office or call the national information number, both of which are listed below. A copy of the Superfund TAG Handbook, which contains the necessary application and forms, is available free by calling the EPA Region 10 Superfund Office:

EPA Region 10 TAG Coordinator
Superfund Branch
1200 6th Avenue HW-117 (CR)
Seattle, Washington 98101
(206) 553-0603 or Superfund toll-free hotline (800) 424-4372

**LEGEND**

- Marshy area
 Existing monitoring well location
 Existing borehole location
A-A' Cross-Section
A''-A''' Cross-Section

0 500 1000
Scale in Feet

Reference: E & E 1991

DEPARTMENT OF THE ARMYALASKA DISTRICT, CORPS OF ENGINEERS
ANCHORAGE, ALASKA

FAIRBANKS, ALASKA

FORT WAINWRIGHT, OPERABLE UNIT 4

**GEOLOGIC
CROSS-SECTION
LOCATIONS**

DESIGNED:

DRAWN: EGM

TRACED:

CHECKED: LD

SUBMITTED:

CHIEF

RECOMMENDED:

CHIEF

SECTION

DRAWING NUMBER

KPF3-4.DWG

RECOMMENDED:

SCALE:

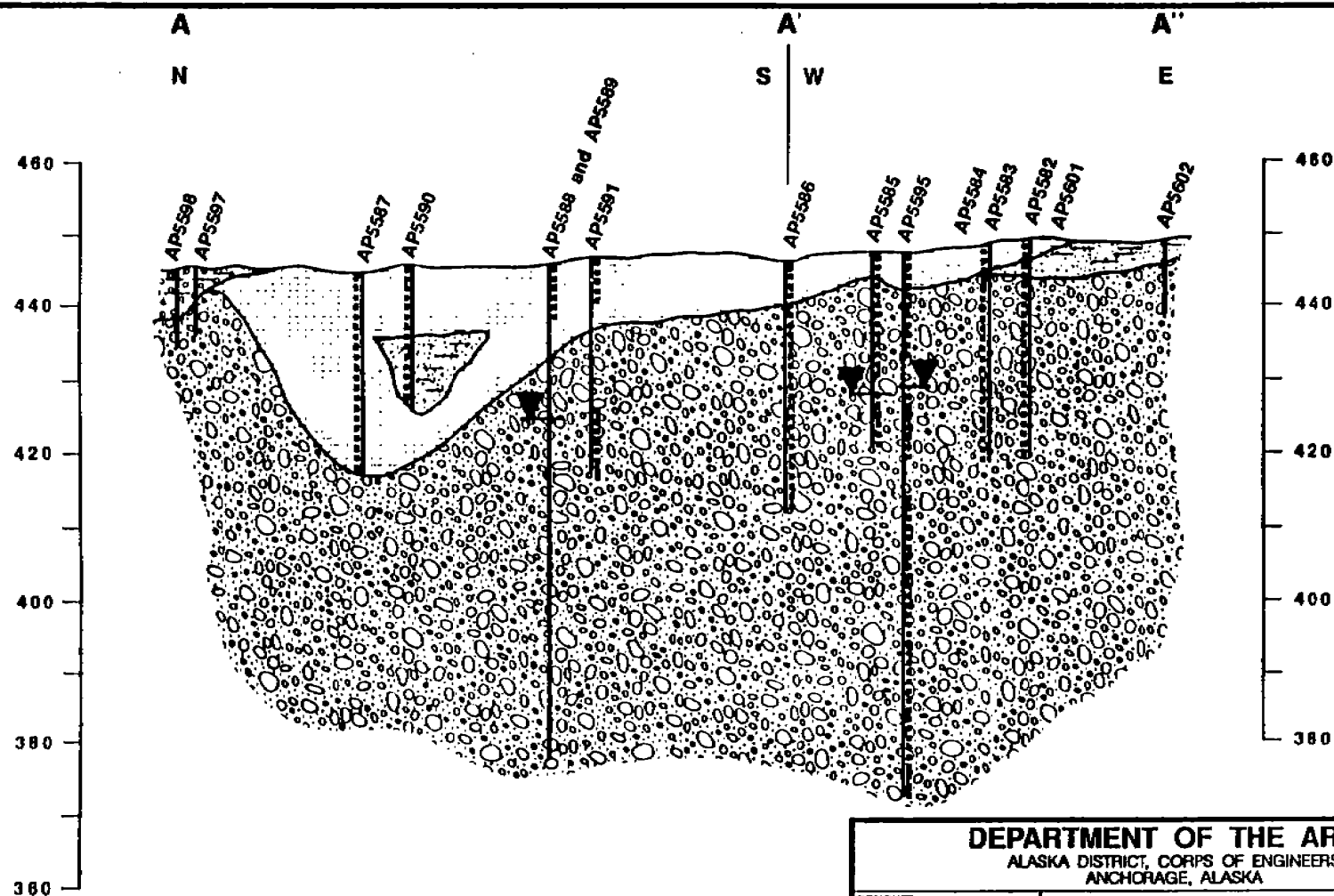
PLATE NUMBER

FIGURE 3-4



DATE:

03-03-93

C:\CORP\KPS200\KPF3-4 MARCH, 3, 1993



LEGEND

- | | | | |
|---|--------------------------|---|---|
|  | Sand and gravel |  | Sand and gravel w/ silt |
|  | Silt |  | Water table
(Measured during drilling) |
|  | Sandy silt to silty sand |  | Frozen soil |

DEPARTMENT OF THE ARMY

ALASKA DISTRICT, CORPS OF ENGINEERS
ANCHORAGE, ALASKA

DESIGNED:

DRAWN: RSM

TRACED:

CHECKED: L. DIEDIKER

SUBMITTED:

CHIEF:

SECTION:

RECOMMENDED:

CHIEF:

FAIRBANKS, ALASKA
FORT WAINWRIGHTGEOLOGIC CROSS-SECTION
WEST AND SOUTH OF
THE LANDFILL

RECOMMENDED:

CHIEF, ENGINEERING DIVISION

DATE:

11-16-92

DRAWING NUMBER

1619FG.CDR
KQ5901

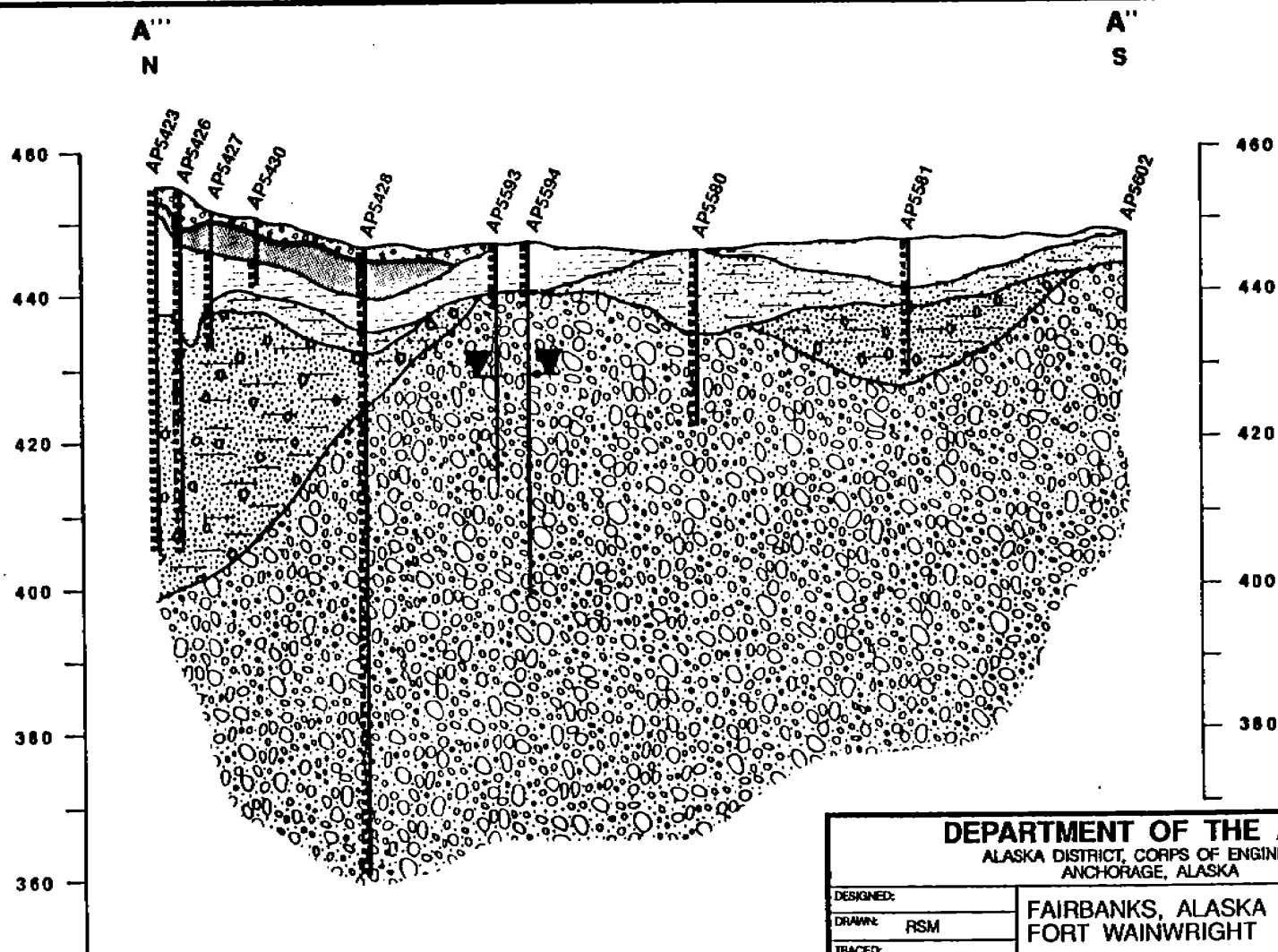
SCALE:

PLATE NUMBER

FIGURE 3-5

SHEET

OF



LEGEND

- | | |
|---------------------------|---|
| Peat w/ intermittent silt | Gravel and silt |
| Sand & gravel | Sand and gravel w/ silt |
| Silt | Water table
(Measured during drilling) |
| Sandy silt to silty sand | Frozen soil |

DEPARTMENT OF THE ARMY

ALASKA DISTRICT, CORPS OF ENGINEERS
ANCHORAGE, ALASKAFAIRBANKS, ALASKA
FORT WAINWRIGHTGEOLOGIC CROSS-SECTION
EAST OF THE LANDFILL

DESIGNED:
DRAWN: RSM
TRACED:
CHECKED: L. DIEDIKER
SUBMITTED:
CHIEF: SECTION

RECOMMENDED:

CHIEF:

DRAWING NUMBER

1620FG.CDR

KQ5901

RECOMMENDED:

SCALE:

SHEET

OF

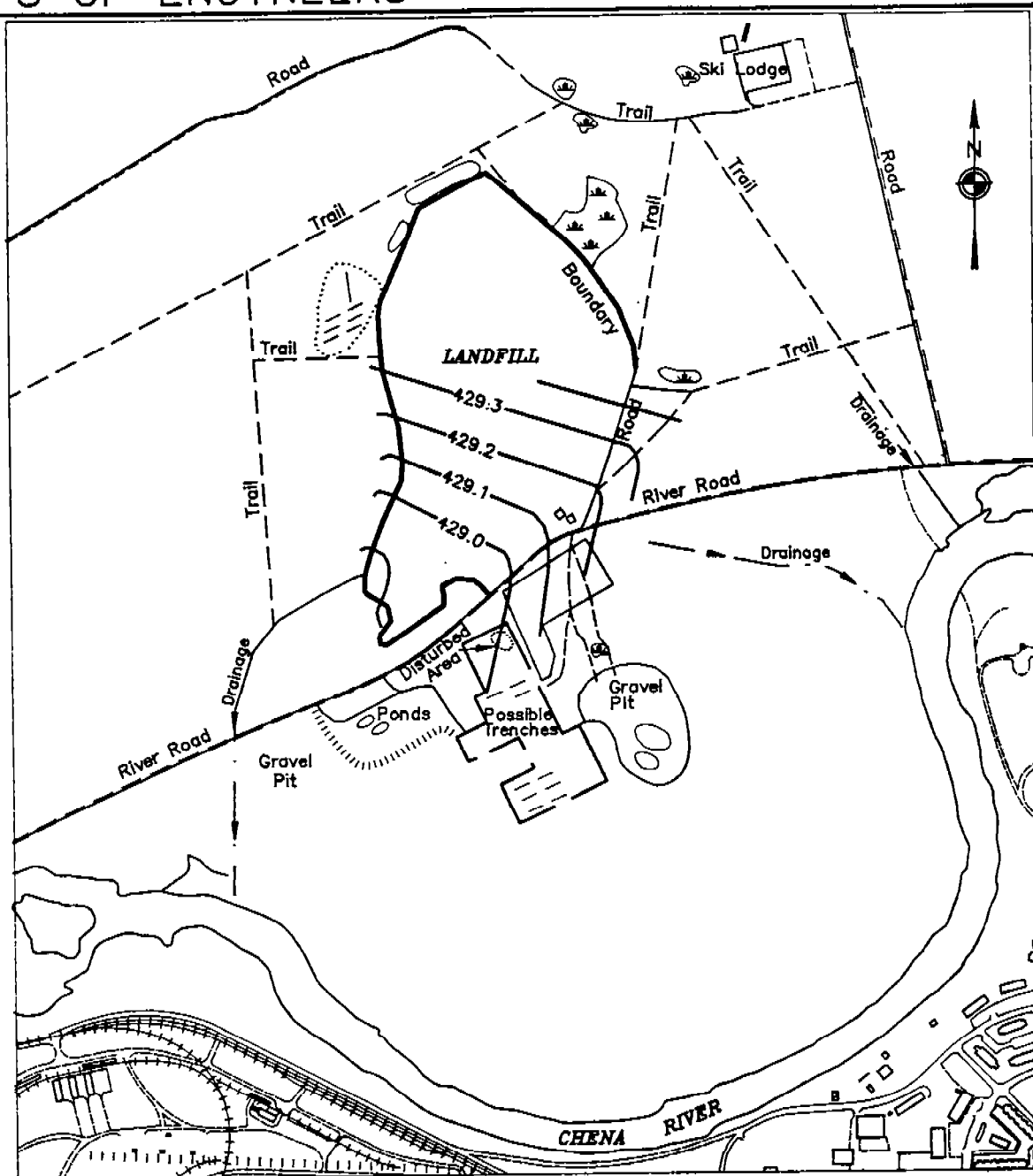
CHIEF, ENGINEERING DIVISION

PLATE NUMBER

FIGURE 3-6

DATE:

11-16-92

**LEGEND**

Marshy area
Contour Interval 0.1 Feet

0 500 1000
Scale in Feet

Reference: E & E 1991

DEPARTMENT OF THE ARMY

ALASKA DISTRICT, CORPS OF ENGINEERS
ANCHORAGE, ALASKA

DESIGNED:

DRAWN: EGM

TRACED:

CHECKED: LD

SUBMITTED:

CHIEF

RECOMMENDED:

CHIEF

FAIRBANKS, ALASKA

FORT WAINWRIGHT, OPERABLE UNIT 4

GROUNDWATER CONTOUR MAP-
LANDFILL AREA
(AUGUST 22, 1990)

RECOMMENDED:

CHIEF, ENGINEERING DIVISION

DATE:

02-23-93

DRAWING NUMBER

KPF3-7.DWG

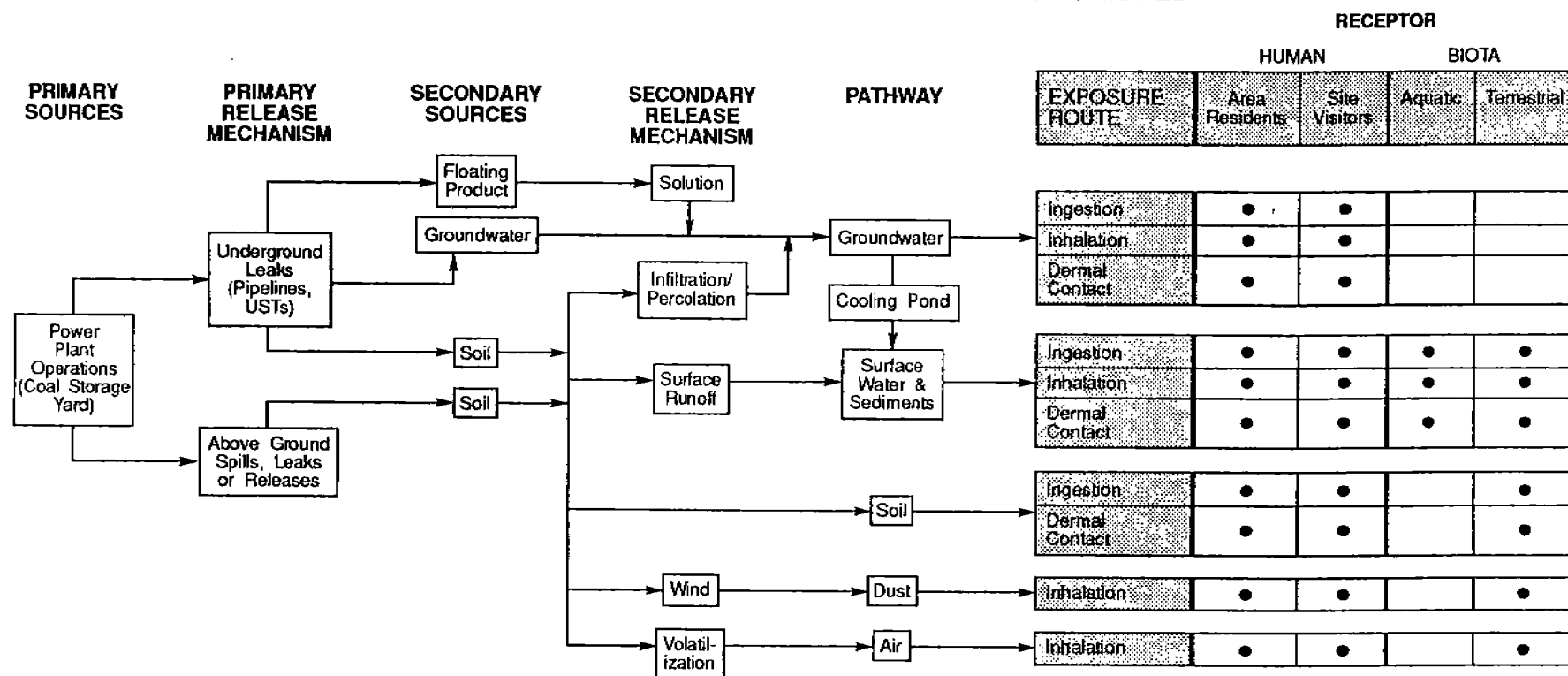
SCALE:

PLATE NUMBER

FIGURE 3-7

C:\CORP\KPF5200\KPF3-7 FEB 23, 1993

POWER PLANT COAL STORAGE YARD CONCEPTUAL MODEL



DEPARTMENT OF THE ARMY

ALASKA DISTRICT, CORPS OF ENGINEERS
ANCHORAGE, ALASKA

DESIGNED:
DRAWN: AES
TRACED:
CHECKED: D. ANDERSON
SUBMITTED:
CHIEF: SECTION

FAIRBANKS, ALASKA
FORT WAINWRIGHT
**POWER PLANT COAL
STORAGE YARD CONCEPTUAL
SITE MODEL OU-4**

RECOMMENDED:
CHIEF: SECTION

RECOMMENDED:
CHIEF, ENGINEERING DIVISION

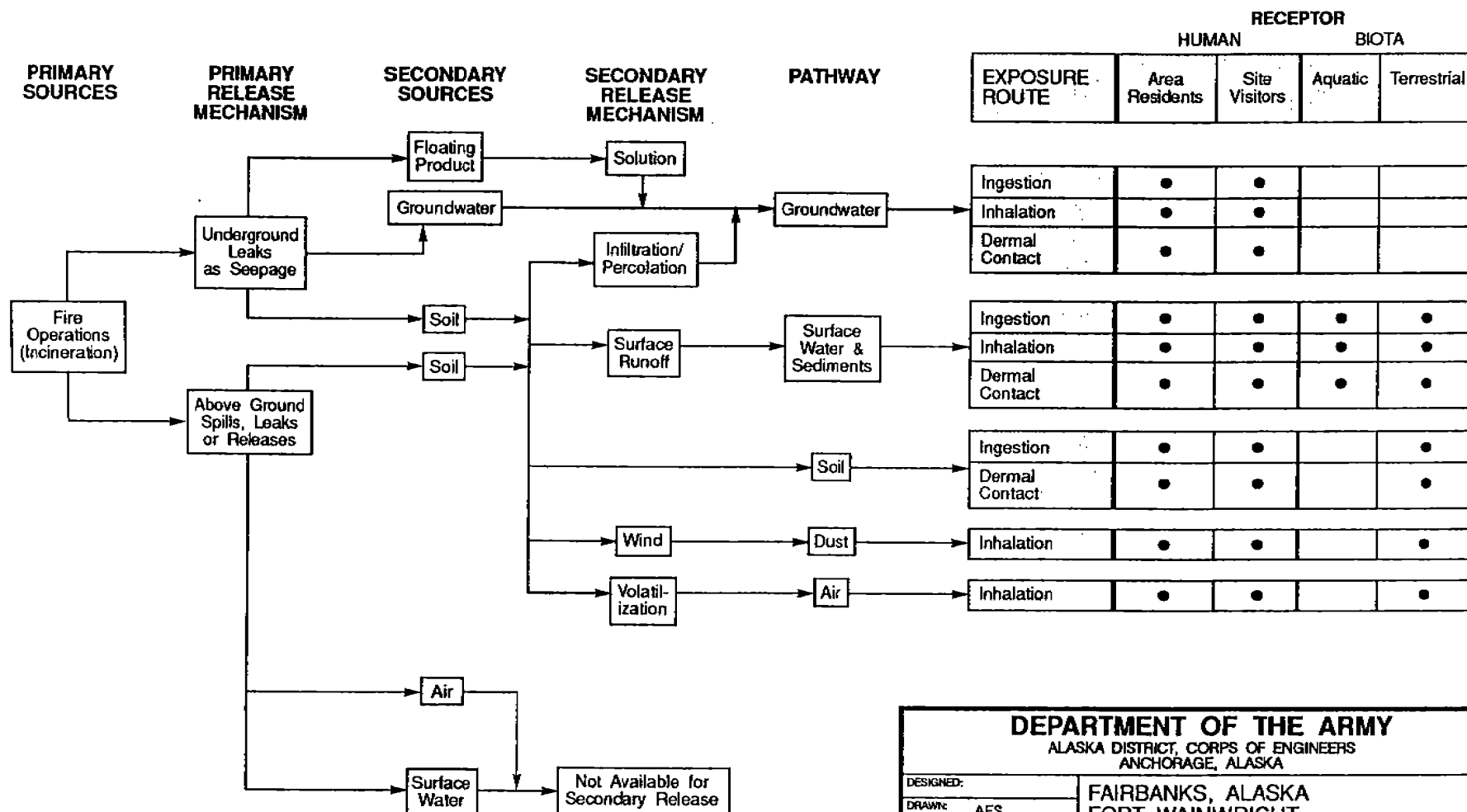
DATE:
11-17-92

DRAWING NUMBER
1486CH.CDR
KQ5901

SCALE:
PLATE NUMBER
FIGURE 3-8

SHEET OF

FIRE TRAINING PITS CONCEPTUAL MODEL



DEPARTMENT OF THE ARMY

ALASKA DISTRICT, CORPS OF ENGINEERS
ANCHORAGE, ALASKADESIGNED:
DRAWN: AES
TRACED:
CHECKED: D. ANDERSON
SUBMITTED:
CHIEF: SECTIONFAIRBANKS, ALASKA
FORT WAINWRIGHT
**FIRE TRAINING PITS
CONCEPTUAL
SITE MODEL OU-4**RECOMMENDED:
CHIEF: SECTIONRECOMMENDED:
CHIEF, ENGINEERING DIVISIONDATE:
11-17-92

DRAWING NUMBER

1488CH.CDR
KQ5901

SCALE:

PLATE NUMBER

FIGURE 3-9

SHEET OF

4. MANAGEMENT PLAN RATIONALE

This section presents the rationale used in planning the OU-4 RI/FS activities. The primary goals for the project are defined, and the data necessary to achieve these goals are identified. The section concludes with a discussion of the overall objectives and approach to collecting the required information.

4.1 PROJECT DATA REQUIREMENTS AND QUALITY CONSIDERATIONS

Consistent with EPA guidance, the primary goals for the OU-4 RI/FS are defined as follows:

- Assess current site conditions;
- Identify and evaluate human health and environmental risks; and
- Evaluate alternative remedial action technologies.

As the initial step toward accomplishing these goals, a preliminary scoping of the RI/FS was performed based on a review of available background documents, site visits, and interviews with Fort Wainwright personnel. Upon evaluation of this information, this Management Plan and associated documents were developed through the following steps:

- A CSM was prepared for each source area based on the natural environmental setting and identified contaminants on-site. An analysis of potential contaminant transport pathways and receptors was performed to aid in identifying critical decision points/data needs.
- ARARs were reviewed for potential cleanup criteria.
- Preliminary remedial action objectives and alternatives were defined.

- Data gaps were identified, associated RI/FS objectives were defined, and specific types, amounts, and quality concerns for data needed to fill the gaps and meet the objectives were specified.

Development of the CSMs, discussed in Section 3.1, resulted in the identification of several specific types of data required to satisfy the goals of the OU-4 RI/FS (see Tables 3-1 through 3-3). These data requirements are summarized in Tables 4-1 through 4-3 as they relate to each of the source areas. Tables 4-1 through 4-3 also provide a brief indication of the intended use(s) of the data and describe the primary source and/or collection method for the information.

The quantity and quality of data required to fill the gaps and confidently accomplish the project goals is determined based primarily on the intended data use(s), expected contaminants and levels of concern, required analytical detection limits, and preferred analytical quality levels (EPA 1987). Data to be used in support of decisions of the highest relative importance to the project necessarily require relatively high confidence and quality. For example, decisions related to actual releases and off-site migration of contaminants or exposures and risks to receptors are expected to be of primary concern in the OU-4 project because of the potentially serious consequences associated with making an incorrect decision. Accordingly, chemical data for multimedia samples generally will also require a relatively high level of quality. In contrast, data used as indirect indicators of contaminant migration potential (i.e., physical data used primarily for site characterization purposes) generally can be of lesser quality.

The quality levels defined by EPA (1987a, b) define the analytical requirements in relation to the EPA's Contract Laboratory Program (CLP). Although samples for OU-4 will not be analyzed in the CLP, the quality levels presented in Tables 4-1 through 4-3 define the expected laboratory methods and deliverables. Level V is generally defined as CLP Special Analytical Services (SAS), which use non-standard methods for unique analytes or modified analytical methods designed to achieve lower detection limits. Level IV requires complete analytical data packages for validation and documentation purposes. Level III requires equivalent methods, results reported only in limited QC data summaries and no raw data for validation unless specifically requested. The other quality levels apply as defined in the EPA guidance.

In general, data collected during the OU-4 RI/FS will be used to conduct an assessment of risk to human health and the environment, including documentation of contaminant concentrations and physical characterization of potential contaminant migration pathways. Other data-use

categories include general site characterization, plume delineation, and evaluation of remedial alternatives during the FS. The overall objectives and strategy by which these data will be collected is the topic of the remainder of this section. Additional detail pertaining to the field elements of the proposed plan are provided in Section 5 and the SAP (Appendix A).

4.2 PROJECT OBJECTIVES AND APPROACH

Based on the data gaps and quality considerations specified in Section 3 and summarized in Tables 4-1 through 4-3, and in consideration of the previously specified project goals, the principal objectives of the OU-4 RI/FS are as follows:

- Gather historical information of site operations to aid in determination of source(s) and constituents of contamination;
- Characterize surface and subsurface soils as to the magnitude and extent of contamination;
- Characterize groundwater as to the magnitude and extent of contamination and potential for contaminant migration;
- Characterize sediments and surface water as to the magnitude of contaminant residuals that may be indicative of continuing sources; and
- Examine the potential transport mechanisms and pathways for consideration in potential risks to human health and the environment, and in remedial action alternatives.

To accomplish these goals, the following specific RI/FS activities will be performed.

Remedial Investigation Activities:

- Project Planning
- Field Investigations
- Sample Analysis/Data Validation
- Risk Assessment

Feasibility Study Activities:

- Remedial Alternatives Development and Screening
- Detailed Analysis of Alternatives
- Reporting

The proposed project tasks are described in more detail in Section 5. The overall plan was designed to minimize the need for additional work and to enable a more focused approach for subsequent efforts, if necessary. Data collected during the RI/FS will be considered along with data available from previous investigations to provide a basis for evaluation of OU-4.

In general, the RI/FS process usually involves a phased approach to allow for the collection of additional, focused data as the understanding of current site conditions and contaminant release/migration mechanisms is refined. For the OU-4 sites, it is possible that additional phases of data collection may be necessary to adequately and cost-effectively define the extent of contamination, evaluate contaminant transport mechanisms, and perform treatability/pilot studies, etc.

Table 4-1
DATA QUALITY OBJECTIVES
Landfill

Objective	Data Needs	Data Use	Data Quality Level	Sampling Approach
Gather historical information on site operations to aid in determination of source contamination.	Records review, interviews, previous investigation documents.	Background information for developing data quality objectives	N/A	Coordinate with community involvement programs for possible information sources. Interview past and present employees. Review ADCOE, ADEC, and Fort Wainwright files.
Gather relevant existing information needed for the investigation.	Literature search.	Source and regional background information.	N/A	Demographic information from census data - Department of Commerce, Fairbanks Drinking Wells - Fairbanks MUS and ADEC Ecological Data - Alaska Department of Fish and Game, USFWS, AEIDC, DPW, USDOJ, Climatic Data
Geophysical Survey				
Examine absence or presence of permafrost at areas identified for soil boring/monitoring well installation.	Electromagnetic conductivity soundings in the immediate area of drilling locations.	Site characterization.	N/A	Perform EM-31 survey in the immediate area of each drilling location.
Establish the absence or presence of a permafrost thaw bulb in the subsurface beneath the landfill.	EM conductivity depth soundings coordinated with GPR transects of the landfill.	Site characterization	N/A	Perform EM-31/EM-34 and GPR surveys of the landfill, coordinating with the known subsurface geology to determine the extent of permafrost and if a thaw bulb exists at the landfill.
Examine locations of subsurface piping or other obstacles for drilling locations.	GPR profiles in immediate area of drilling locations.	Site characterization.	N/A	Perform GPR traverses in the immediate area of each drilling location.
Surface Soils				
Define surface contamination to determine extent and type of contamination.	Obtain surface soil samples for characterization of contamination.	Risk assessment Site characterization	III, V	Collect surface soil samples from soils in areas of concentrated surface runoff or staining and from the former trench area. Analyze all samples for VOC, semi-VOC, TOC, TAL metals, herbicides, petroleum hydrocarbon classification, TRPH, and pest/PCBs.

4-5

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Table 4-1
DATA QUALITY OBJECTIVES
Landfill

Objective	Data Needs	Data Use	Data Quality Level	Sampling Approach
Define physical/chemical/biological properties for evaluation in treatability studies and engineering alternatives.	Atterberg limits, specific gravity, moisture content, and grain size.	Remediation options Engineering studies	III, V	Collect surface soil samples for physical/chemical/biological parameters where remedial activities of surface soils are most likely to occur. Additional chemical parameters will include NO ₃ /NO ₂ , phosphorus, Atterburg limits, grain size, moisture content, specific gravity.
Determine background surface soil levels to aid in evaluation of site data.	Collect background surface soil samples at locations.	Evaluation of on-site data.	III, V	Collect surface soil samples from off-site locations. Analyze for VOC, semi-VOC, pest/PCBs, herbicides, TAL metals, TOC, TRPH and petroleum hydrocarbon classification.
Subsurface Soils				
Define subsurface contamination to estimate volume and type of contamination.	Contamination characteristics.	Risk assessment Degree of contamination Extent of contamination Site characterization	III, V	Install boring locations in areas surrounding the landfill and trenches. Collect split tube samples from each boring. Samples will be analyzed for TAL metals, VOCs, semi-VOC, pest/PCBs, herbicides, TOC, TRPH and petroleum hydrocarbon classification.
Define physical/chemical properties for evaluation of treatability studies, engineering alternatives, and subsurface modeling.	Obtain samples for grain size, Atterberg limits, specific gravity and moisture where remedial activities in subsurface soils are most likely.	Engineering studies Feasibility studies Remediation options	III, V	Analyze split tube samples from borings for physical parameters. Additional chemical parameters will include phosphorus and NO ₃ /NO ₂ .
Determine background subsurface soil levels to aid in evaluation of site data.	Collect background subsurface soil samples from locations uninfluenced by source areas.	Evaluation of on-site data.	III, V	Collect subsurface soils from off-site locations. Analyze representative samples per boring for TAL metals, VOC, semi-VOC, pest/PCBs, herbicides, TOC, TRPH and petroleum hydrocarbon classification.

Table 4-1
DATA QUALITY OBJECTIVES
Landfill

Objective	Data Needs	Data Use	Data Quality Level	Sampling Approach
Groundwater				
Determine shallow permafrost-free aquifer contamination and physical characteristics to assess plume migration in the permafrost-free aquifer.	Collect groundwater samples from wells in the permafrost-free aquifer.	Site characterization Risk assessment Engineering/Feasibility studies	III, V	Install wells in the permafrost-free aquifer. Sample groundwater for VOC, semi-VOC, total and dissolved PP metals, pest/PCBs, tetrahydrofuran, herbicides, anions/cations, total dissolved solids, alkalinity, explosive residue, TOC, TRPH, petroleum hydrocarbon classification, BOD, potassium, and NO ₃ /NO ₂ .
Determine deep aquifer contaminant characteristics and physical characteristics to assess plume migration in the deep aquifer.	Collect groundwater samples from deep wells.	Site characterization Risk assessment Engineering/Feasibility studies	III, V	Install deep wells. Sample groundwater for chemical parameters described above.
Determine background groundwater levels to aid in evaluation of site data.	Collect groundwater sample from off-site wells.	Evaluation of on-site data Risk assessment	III, V	Install off-site wells. Sample groundwater for VOC, semi-VOC, total and dissolved PP metals, pest/PCBs, anions/cations, TRPH, petroleum hydrocarbon classification, total dissolved solids, alkalinity, TOC, BOD, potassium, NO ₃ /NO ₂ , tetrahydrofuran, and explosive residues.
Obtain groundwater contaminant information.	Collect groundwater samples from existing wells.	Site characterization Feasibility studies Risk assessment	III, V	Collect groundwater samples from existing wells. Analyze for VOC, semi-VOC, total and dissolved PP metals, pest/PCBs, herbicides, TRPH, petroleum hydrocarbon classification, anions/cations, total dissolved solids, alkalinity, TOC, BOD, potassium, NO ₃ /NO ₂ , tetrahydrofuran, and explosive residues.
Assess local hydraulic characteristics of aquifer(s)	Hydraulic conductivity, transmissivity, storativity, gradient, and flow direction.	Site characterization Feasibility studies	I	Perform slug tests and/or pump tests, collect water level data from monitoring wells and piezometer nests.

4-7

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Table 4-1
DATA QUALITY OBJECTIVES
Landfill

Objective	Data Needs	Data Use	Data Quality Level	Sampling Approach
Obtain data on groundwater parameters during sampling	pH, conductivity, dissolved oxygen, temperature, turbidity, and redox potential.	Site characterization Feasibility studies	I	Mobilize appropriate instrumentation to well location for measurement during sampling of all wells.
Surface Water				
Determine if local surface waters have been impacted by groundwater discharge or surface runoff.	If water exists in drainage ditches or wetlands, water samples will be collected. Surface water samples from the Chena River may be collected.	Site characterization Risk assessment	III, V	Surface water samples from the drainage ditch wetlands, and the Chena River will be collected in conjunction with the sediment samples. Analytes will include VOC, semi-VOC, pest/PCBs, herbicides, TRPH, petroleum hydrocarbon classification, total dissolved solids, total and dissolved PP metals, alkalinity, anions/cations, and NO ₃ /NO ₂ .
Determine background surface water concentrations to aid in evaluation of site data.	Collect background surface water samples.	Evaluation of site data Risk assessment	III, V	Collect surface water from the wetlands and the Chena River in conjunction with background sediment samples. Analyze for VOC, semi-VOC, total and dissolved PP metals, pest/PCBs, herbicides, TRPH, petroleum hydrocarbon classification, total dissolved solids, alkalinity, anions/cations, and NO ₃ /NO ₂ .
Obtain data on surface water parameters during sampling.	pH, conductivity, dissolved oxygen, temperature, turbidity, and redox potential.	Site characterization	I	Mobilize appropriate instrumentation to sampling locations for measurement during sampling activities.
Sediments				
Determine if sediments in wetlands, the drainage route, and Chena River have been impacted by surface runoff or groundwater discharge.	Sample sediments in wetlands, the drainage route, and Chena River.	Site characterization Risk assessment	III	Collect sediment samples from wetlands or on-site drainage route. Analyze for VOC, semi-VOC, TAL metals, pest/PCBs, herbicides, TOC, NO ₃ /NO ₂ , TRPH, petroleum hydrocarbon classification, grain size, and sediment toxicity.

Table 4-1
DATA QUALITY OBJECTIVES
Landfill

Objective	Data Needs	Data Use	Data Quality Level	Sampling Approach
Determine background sediment levels to aid in evaluation of site data.	Collect background sediment samples from wetlands and the drainage routes.	Evaluation of site data Risk assessment	III	Background sample will be collected from sediments in wetlands and from the Chena River. Analyze for VOC, semi-VOC, TAL metals, TRPH, petroleum hydrocarbon classification, pest/PCBs, herbicides, TOC, and sediment toxicity.
Ash Samples				
Characterize contaminants in ash used as cover material.	Contaminant characterization.	Identify ash as a possible source Engineering/feasibility studies	III, V	Collect samples of ash for dioxin, pest/PCBs, herbicides, TAL metals, and semi-VOCs.
Determine airborne exposure potential	Grain size	Risk assessment	III, V	Collect ash samples for sieve analysis.
Air Samples				
Determine nature and potential contamination dispersion in air.	Obtain air samples for characterization.	Risk assessment Site characterization	III	Collect air samples from areas downwind of the landfill. Analyze samples for TAL metals.
Determine background air levels to aid in evaluation of site data.	Collect background air samples at two locations	Evaluation of on-site data	III	Collect air samples from upwind location. Analyze samples for TAL metals.

BOD - Biological oxygen demand
 GPR - Ground penetrating radar
 NO₂ - Nitrite
 NO₃ - Nitrate
 Pest/PCB - Pesticide/Polychlorinated biphenyls
 PP - Priority pollutant

Semi-VOC - Semivolatile organic compounds
 TAL - Target analyte list
 TOC - Total organic carbon
 TRPH - Total recoverable petroleum hydrocarbons
 VOC - Volatile organic compounds

Table 4-2

DATA QUALITY OBJECTIVES
Power Plant Coal Storage Yard

Objective	Data Needs	Data Use	Data Quality Level	Sampling Approach
Gather historical information on site operations to aid in determination of source contamination.	Records review, interviews.	Background information Define primary contamination source	N/A	Coordinate with community involvement programs for possible information sources. Interview past and present employees. Review ADCOE, ADEC, and Fort Wainwright files.
Validate data from 1991 investigations at Coal Storage Yard	Laboratory data packages acquired during 1991 investigation	Site characterization Degree of contamination	Level IV	Evaluate existing data for 1991 investigations at CSY. Ten percent of the data will be validated as for EPA Level IV.
Gather relevant existing information needed for the investigation.	Literature search.	Source and regional background information.	N/A	Demographic information from census data - Department of Commerce, Fairbanks Drinking Wells - Fairbanks MUS and ADEC Ecological Data - Alaska Department of Fish and Game, USFWS, AEIDC, DPW, USDOJ. Climatic Data - AEIDC, NWS Geologic/Hydrogeologic Information - USGS Floodplain - ADCOE
Geophysical Survey				
Examine absence or presence of permafrost at areas identified for soil boring monitoring well installation.	Electromagnetic conductivity soundings in the immediate area of drilling locations.	Site characterization	N/A	Perform EM-31 survey in the immediate area of each drilling location.
Examine locations of sub-surface piping, tanks, or other obstacles for drilling locations.	GPR profiles in immediate area of drilling locations.	Site characterization	N/A	Perform GPR traverses in the immediate area of each drilling location.
Surface Soils				
Define optimum soil sample locations during field investigations.	Obtain screening data for TPH as diesel or gasoline in soil samples.	Evaluate concentrations of primary petroleum contaminants to locate extent of potential plume.	II	Screen soil samples using field portable GC for determining concentrations of BTEX at 5 ppm or greater.

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Table 4-2

DATA QUALITY OBJECTIVES
Power Plant Coal Storage Yard

Objective	Data Needs	Data Use	Data Quality Level	Sampling Approach
Define surface contamination to determine extent and type of contamination.	Obtain surface soil samples for characterization of contamination.	Risk assessment Site characterization	III, V	Collect surface soil samples. All samples will be analyzed for VOC, semi-VOC, TAL metals, TRPH, petroleum hydrocarbon classification, pest/PCB, herbicides, dioxin, and TOC.
Define physical/chemical/biological properties for evaluation in treatability studies and engineering alternatives.	Atterburg limits, specific gravity, moisture content, and grain size.	Remediation options Engineering studies	III, IV	Collect surface soil samples for physical/chemical/biological parameters where remedial activities are most likely to occur. Additional chemical parameters include phosphorus, Atterburg limits, grain size, moisture content, specific gravity, and NO ₃ /NO ₂ .
Determine background surface soil levels to aid in evaluation of site data.	Collect background surface soil samples at off-site locations.	Evaluation of site data. Risk assessment	III, V	Collect surface soil samples from two off-site location. Analyze for VOC, semi-VOC, TAL metals, petroleum hydrocarbon classification, TRPH, pest/PCB, herbicides, dioxin, and TOC.
Subsurface Soils				
Define optimum soil boring locations during field investigations.	Screening data for BTEX in soil samples.	Evaluate concentrations of primary petroleum contaminants to locate extent of potential plume.	II	Screen soil samples using field portable GC for determining concentrations at 5 ppm or greater.
Define subsurface contamination to estimate volume and type of contamination.	Contamination characteristics.	Risk assessment Degree of contamination Extent of contamination Site characterization	III, V	Install boring locations. Collect split-tube samples from each boring. Analyze all samples for VOC, semi-VOC, TAL metals, TRPH, petroleum hydrocarbon classification, pest/PCB, herbicides, dioxin, and TOC.
Define background subsurface soil concentrations to aid in evaluation of site data.	Collect background subsurface soil samples at locations uninfluenced by facility.	Evaluation of on-site data. Risk assessment	III, V	Collect split-tube samples from two off-site boring locations. Analyze samples for VOC, semi-VOC, TAL metals, petroleum hydrocarbon classification, pest/PCB, herbicides, dioxin, TOC, and TRPH.

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Table 4-2
DATA QUALITY OBJECTIVES
Power Plant Coal Storage Yard

Objective	Data Needs	Data Use	Data Quality Level	Sampling Approach
Define physical/chemical/biological properties for evaluation in treatability studies and engineering alternatives.	Atterburg limits specific gravity, moisture content, and grain size.	Remediation options, engineering studies.	III, IV	Collect surface soil samples for physical/chemical/biological parameters where remedial activities are most likely to occur. Additional chemical parameters include phosphorous, Atterburg limits, grain size, moisture content, specific gravity, and NO ₃ /NO ₂ .
Groundwater				
Determine shallow aquifer contaminant characteristics to initially assess plume migration in the shallow aquifer, and presence or absence of permafrost.	Collect groundwater samples from shallow wells.	Site characterization Risk assessment	III, V	Install wells in the shallow aquifer or in an aquifer where no permafrost exists. Sample groundwater for VOC, semi-VOC, petroleum hydrocarbon classification, total and dissolved PP metals, TRPH, pest/PCB, herbicides, dioxin, anions/cations, total dissolved solids, alkalinity, TOC, BOD, NO ₃ /NO ₂ and potassium.
Determine deep aquifer contaminant characteristics.	Collect groundwater samples from a deep well.	Site characterization Risk assessment	III, V	Install one deep well. Sample groundwater for VOC, semi-VOC, petroleum hydrocarbon classification, total and dissolved PP metals, TRPH, pest/PCB, herbicides, dioxin, anions/cations, total dissolved solids, alkalinity, TOC, BOD, NO ₃ /NO ₂ , and potassium.
Determine background groundwater concentrations to aid in evaluation of site data.	Collect groundwater samples from shallow off-site wells.	Evaluation of site data. Risk assessment	III, V	Install shallow wells upgradient. Sample groundwater for VOC, semi-VOC, petroleum hydrocarbon classification, total and dissolved PP metals, TRPH, pest/PCB, herbicides, dioxin, anions/cations, total dissolved solids, alkalinity, TOC, BOD, NO ₃ /NO ₂ , TRPH, and potassium.
Obtain groundwater contaminant information.	Collect groundwater samples from 17 existing wells.	Site characterization Risk assessment	III, V	Collect groundwater samples from existing wells for VOC, semi-VOC, petroleum hydrocarbon classification, total and dissolved PP metals, TRPH, pest/PCB, herbicides, dioxin, anions/cations, total dissolved solids, alkalinity, TOC, BOD, NO ₃ /NO ₂ , and potassium.

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Table 4-2
DATA QUALITY OBJECTIVES
Power Plant Coal Storage Yard

Objective	Data Needs	Data Use	Data Quality Level	Sampling Approach
Determine contaminant characteristics in supply wells.	Collect groundwater samples from five supply wells.	Risk assessment	III, V	Sample water supply wells downgradient and crossgradient of the Power Plant Coal Storage Yard. Sample groundwater for chemical parameters described above.
Assess local hydraulic characteristics of aquifer(s)	Hydraulic conductivity, transmissivity, storativity, gradient, and flow direction.	Site characterization Risk assessment	I	Perform slug test and/or pump test, collect water level data from monitoring wells and piezometer nest.
Obtain data on groundwater parameters during sampling.	pH, conductivity, dissolved oxygen, temperature, turbidity, and redox potential.	Site characterization	I	Mobilize appropriate instrumentation to well location for measurement during sampling of all wells.
Surface Water				
Determine if surface water has been impacted by groundwater discharge or surface runoff.	Identify contaminant characteristics of surface water samples from the drainage pathways, if present.	Site characterization Risk assessment	III, V	Surface water samples will be collected from the drainage pathways, and analyzed for VOC, semi-VOC, total and dissolved PP metals, TRPH, petroleum hydrocarbon classification, pest/PCB, herbicides, dioxin, total dissolved solids, alkalinity, anions/cations, and NO ₃ /NO ₂ .
Confirm that cooling pond waters are not being impacted.	Surface water samples at random locations.	Site characterization Risk Assessment	III, V	Collect surface water samples at random locations in the cooling pond. Analyze for VOC, semi-VOC, total and dissolved PP metals, TRPH, petroleum hydrocarbon classification, pest/PCB, dioxin, total dissolved solids, herbicides, alkalinity, anions/cations, and NO ₃ /NO ₂ .
Obtain data on surface water parameters during sampling.	pH, conductivity, dissolved oxygen, temperature, and redox potential.	Site characterization	I	Mobilize appropriate instrumentation to sampling location for measurement during sampling activities.

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Table 4-2

DATA QUALITY OBJECTIVES
Power Plant Coal Storage Yard

Objective	Data Needs	Data Use	Data Quality Level	Sampling Approach
Sediments				
Determine if sediments have been impacted by groundwater discharge or surface runoff.	Identify contaminant characteristics of sediment samples from drainage pathways.	Site characterization Risk assessment	III, V	Collect sediment samples from drainage pathways. Analyze for VOC, semi-VOC, TAL metals, TRPH, petroleum hydrocarbon classification, pest/PCB, herbicides, dioxin, and TOC.
Determine if sediments within the cooling pond have been impacted.	Analyze sediment samples where groundwater enters the cooling pond.	Site characterization Risk assessment	III, V	Collect sediment samples from inlet/outlet and at random locations in the cooling pond. Analyze for VOC, semi-VOC, TAL metals, TRPH, petroleum hydrocarbon classification, pest/PCB, herbicides, and TOC.

BOD - Biological oxygen demand
 BTEX - Benzene, toluene, ethylbenzene, total xylenes
 GC - Gas chromatograph
 GPR - Ground penetrating radar
 NO₂⁻ - Nitrite
 NO₃⁻ - Nitrate
 Pest/PCB - Pest/Polychlorinated Biphenyls

PP - Priority pollutant
 TAL - Target analyte list
 TOC - Total organic carbon
 TRPH - Total recoverable petroleum hydrocarbons
 VOC - Volatile organic compounds

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Table 4-3

DATA QUALITY OBJECTIVES
Fire Training Pits

Objective	Data Needs	Data Use	Data Quality Level	Sampling Approach
Gather historical information of site operations to aid in determination of source contamination.	Records reviews, interviews, previous investigation documents.	Background information for developing data quality objectives	N/A	Coordinate with community involvement programs for possible information sources. Review ADCOE, ADEC, and Fort Wainwright files.
Gather relevant existing information needed for the investigation.	Literature search.	Source and regional background information.	N/A	Demographic information from census data - Department of Commerce, Fairbanks Drinking Wells - Fairbanks MUS and ADEC Ecological Data - Alaska Department of Fish and Game, USFWS, AEIDC, DPW, USDOJ. Climatic Data - AEIDC, NWS Geologic/Hydrogeologic Information - USGS Floodplain - ADCOE
Geophysical Survey				
Examine absence or presence of permafrost at areas identified for soil boring/monitoring well installation.	Electromagnetic conductivity soundings in the immediate area of drilling locations.	Site characterization	N/A	Perform EM-31 survey in the immediate area of each drilling location.
Examine locations of subsurface piping, tanks, or other obstacles for drilling locations.	GPR profiles in immediate area of drilling locations.	Site characterization	N/A	Perform GPR traverses in the immediate area of each drilling location.
Surface Soils				
Define optimum soil sample locations during field investigations.	Screening data for TPH as diesel or gasoline in soil samples.	Evaluate concentrations of primary petroleum contaminants to locate extent of potential plume.	H	Screen all soil samples using optical analyzer or equivalent for determining concentrations at 10 ppm or greater.

Table 4-3

DATA QUALITY OBJECTIVES
Fire Training Pits

Objective	Data Needs	Data Use	Data Quality Level	Sampling Approach
Define surface contamination to determine extent and type of surficial contamination.	Obtain surface soil samples for characterization of contamination.	Risk assessment Site characterization	III, V	Collect surface soil samples from FTPs and surrounding areas. Analyze all samples for VOC, semi-VOC, TAL metals, TRPH, TOC, petroleum hydrocarbon classification, pest/PCB, herbicides, and dioxin.
Define physical/chemical properties for evaluation of treatability studies and remedial alternatives.	Atterberg limits, specific gravity, grain size, and moisture.	Remediation options Feasibility studies	III	Collect surface soil sample for physical/chemical parameters where remedial activities of surface soils are most likely to occur. Additional chemical parameters will include TCLP analysis for VOC, semi-VOC, and metals, NO ₃ /NO ₂ , and phosphorus.
Determine background surface soil levels to aid in evaluation of site data.	Collect background soil samples from one off-site location.	Evaluation of site data. Risk assessment	III, V	Collect surface soil samples from off-site location. Analyze for VOC, semi-VOC, petroleum hydrocarbon classification, TRPH, pest/PCB, herbicides, dioxin, TOC, and TAL metals.
Subsurface Soils				
Define optimum soil boring locations during field investigations.	Screening data for BTEX in soil samples.	Evaluate concentrations of primary petroleum contaminants to locate extent of potential plume	II	Screen all soil samples to identify BTEX concentrations at 5 ppm or greater.
Define subsurface contamination to estimate volume and type of contamination.	Contamination characteristics.	Risk assessment Degree of contamination Extent of contamination Site characterization	III, V	Install soil borings. Collect split tube samples from each boring. All samples will be analyzed for VOC, semi-VOC, TAL metals, TOC, TRPH, petroleum hydrocarbon classification, pest/PCB, herbicides, and dioxin.
Define physical/chemical properties for evaluation of treatability studies, remedial alternatives and subsurface modeling.	Obtain samples for grain size, Atterberg limits, specific gravity and moisture content where remedial activities are most likely.	Remediation options Feasibility studies Engineering studies	III	Analyze split tube samples from borings for physical parameters. Subsurface sample from each aquifer unit will be tested for physical parameters. Additional chemical parameters will include NO ₃ /NO ₂ and phosphorus.

Table 4-3

DATA QUALITY OBJECTIVES
Fire Training Pits

Objective	Data Needs	Data Use	Data Quality Level	Sampling Approach
Define background subsurface soil concentrations to aid in evaluation of on-site data.	Sample subsurface soils from background locations uninfluenced by facility.	Evaluation of on-site data Risk assessment	III, V	Collect split tube samples from off-site borehole locations. Analyze samples for VOC, semi-VOC, TAL metals, TRPH, petroleum hydrocarbon classification, pest/PCB, dioxin, and TOC.
Groundwater				
Determine shallow aquifer (perched by permafrost) contaminant characteristics to initially assess plume migration in the shallow aquifer, and presence or absence of permafrost.	Collect groundwater sample from shallow wells.	Site characterization Risk assessment Feasibility studies	III, V	Install wells in the shallow aquifer or in an aquifer where no permafrost exists. Sample groundwater for VOC, semi-VOC, petroleum hydrocarbon classification, TRPH, total and dissolved PP metals, pest/PCB, herbicides, dioxin, anions/cations, total dissolved solids, alkalinity, TOC, BOD, NO ₃ /NO ₂ , and potassium.
Determine deep aquifer contaminant characteristics.	Collect groundwater samples from one deep well.	Site characterization Risk assessment	III, V	Install one deep well. Sample groundwater for VOC, semi-VOC, petroleum hydrocarbon classification, total and dissolved PP metals, TRPH, pest/PCB, herbicides, dioxin, anions/cations, total dissolved solids, alkalinity, TOC, BOC, NO ₃ /NO ₂ , and potassium.
Determine background groundwater concentrations to aid in evaluation of site data.	Collect groundwater sample from shallow off-site wells.	Evaluation of site data. Risk assessment	III, V	Install shallow upgradient wells. Sample groundwater for VOC, semi-VOC, petroleum hydrocarbon classification, TRPH, total and dissolved PP metals, pest/PCB, herbicides, dioxin, anions/cations, total dissolved solids, alkalinity, TOC, BOD, NO ₃ /NO ₂ , and potassium.
Assess local hydraulic characteristics of aquifer(s).	Hydraulic conductivity, transmissivity, storativity, gradient, and flow direction.	Site characterization Risk assessment	I	Perform slug test and/or pump test, collect water level data from monitoring wells and piezometer nests.

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Table 4-3

DATA QUALITY OBJECTIVES
Fire Training Pits

Objective	Data Needs	Data Use	Data Quality Level	Sampling Approach
Obtain data on ground-water parameters during sampling.	pH, conductivity, dissolved oxygen, and temperature, redox potential.	Site characterization Feasibility studies	I	Mobilize appropriate instrumentation to well location for measurement during sampling of all wells.
Determine contaminant characteristics in existing wells.	Collect groundwater samples from existing wells.	Risk assessment	III	Sample existing wells at the FTPs, sample groundwater for VOC, semi-VOC, petroleum hydrocarbon classification, TRPH, total and dissolved PP metals, pest/PCB, herbicides, dioxins, anions/cations, TDS, TOC, BOD, alkalinity, and potassium.
Surface Water				
Determine if surface water has been impacted by groundwater discharge or surface runoff.	Contaminant characteristics of surface water samples from the drainage pathways.	Site characterization Risk assessment	III, V	Surface water samples will be collected from the drainage pathways, and analyzed for VOC, semi-VOC, total and dissolved PP metals, TRPH, petroleum hydrocarbon classification, pest/PCB, herbicides, dioxin, total dissolved solids, alkalinity, anions/cations, and NO ₃ /NO ₂ .
Determine background surface water concentrations to aid in evaluation of site data.	Contaminant characteristics of background surface water from the drainage pathways.	Evaluation of site data. Risk assessment	III, V	Collect background surface water from the drainage pathways. Analyze for VOC, semi-VOC, total and dissolved PP metals, TRPH, petroleum hydrocarbon classification, pest/PCB, dioxin, total dissolved solids, alkalinity, and anions/cations.
Obtain data on surface water parameters during sampling.	pH, conductivity, dissolved oxygen, temperature, and redox potential.	Site characterization	I	Mobilize appropriate instrumentation to sampling location for measurement during sampling activities.
Sediments				
Determine if sediments have been impacted by groundwater discharge or surface runoff.	Contaminant characteristics of sediment samples from the drainage pathways.	Site characterization Risk assessment	III, V	Collect sediment samples from the drainage pathways. Analyze for VOC, semi-VOC, TAL metals, TRPH, petroleum hydrocarbon classification, TOC, pest/PCB, and dioxin.

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Table 4-3

DATA QUALITY OBJECTIVES
Fire Training Pits

Objective	Data Needs	Data Use	Data Quality Level	Sampling Approach
Determine background sediment concentrations to aid in evaluation of site data.	Collect background sediment sample for contaminant characteristic data.	Evaluation of site data. Risk assessment	III, V	Collect background sediment sample from the drainage pathways. Analyze for VOC, semi-VOC, TAL metals, TRPH, petroleum hydrocarbon classification, TOC, pest/PCB, and dioxin.

BNA - Base neutral/acid
 BOD - Biological oxygen demand
 BTEX - Benzene, toluene, ethylbenzene, total xylenes
 GPR - Ground penetrating radar
 NO₂ - Nitrite
 NO₃ - Nitrate
 Pest/PCB - Pest/Polychlorinated Biphenyls

PP - Priority pollutant
 TAL - Target analyte list
 TOC - Total organic carbon
 TRPH - Total recoverable petroleum hydrocarbons
 VOC - Volatile organic compounds

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5. RI/FS TASKS

This section describes the investigative techniques that will be used to conduct the OU-4 RI/FS. For ease of discussion, RI-related tasks are discussed in Section 5.1, and FS-related tasks are discussed in Section 5.2. In practice, several of the RI and FS activities will be performed concurrently to ensure that the effort is focused on collection of only those data needed to evaluate the particular concerns associated with the OU-4 sites.

5.1 RI TASKS

As outlined in Section 4, the following RI tasks will be performed:

- Project Planning,
- Field Investigations,
- Sample Analysis/Data Validation, and
- Risk Assessment.

The following sections describe the specific objectives and subtasks associated with each of these activities. Task-oriented sampling requirements and procedures are described in detail in the OU-4 SAP (Appendix A).

5.1.1 Project Planning

Project planning covers those subtasks required to initiate project activities, including the preparation of planning documents for performance of the RI/FS and initial evaluation activities to define the project scope. To facilitate implementation, project planning was divided into the subtasks described below.

Collection and Analysis of Existing Data. A comprehensive review of all existing data was performed to form conceptual models of site conditions, establish physical site characteristics, and identify additional sampling needs. As previously noted, this review provided the framework for designing an appropriately focused investigation through which the necessary quantity and quality of data could be collected.

Development of Conceptual Site Models. Following review of the background data, conceptual models of the OU-4 sites were developed to facilitate identification/evaluation of contaminant sources, release mechanisms, transport pathways, exposure routes, and receptors. Key elements of the models are discussed in Section 3.

Identification of Preliminary Remedial Action Objectives. Preliminary remedial action objectives were developed for each contaminated medium, and a preliminary range of remedial action alternatives was identified to assist in developing a properly focused work scope for the project. These objectives and alternatives are presented in Section 3.2.

Preliminary Identification of ARARs. Potential location- and chemical-specific ARARs were identified to help guide the investigation and to assist in the development of alternatives. During the RI/FS, additional location- and action-specific ARARs will be identified. Location-specific ARARs will include, but not be limited to, those related to the historic and ecological significance of the site such as the Archaeological and Historical Preservation Act (and state counter parts), Endangered Species Act, and Wilderness Act. Final determinations of the applicability or relevance and appropriateness of particular standards will not be made until remedial alternatives are examined during the FS.

Identification of DQOs. Critical to the successful performance of the RI is the establishment of specific DQOs for the project. The approach used herein to develop DQOs was based on guidance provided in EPA's Data Quality Objectives for Remedial Response Activities (1978). Using this guidance, DQOs were systematically defined to ensure that the data to be collected are of sufficient quality and quantity for their intended uses.

A three-step process involving identification of decision types, delineation of data uses/needs, and design of the data collection program was used. Tables 4-1 through 4-3 summarize the results of these activities.

Products of the RI planning efforts in Task 1 included the project Management Plan presented herein, which consists of the SAP, the QAPjP, the SSHSP, and the ARARs report and SSCRP, which is bound separately.

5.1.2 Field Investigations

The field investigation program for OU-4 has been designed to provide the maximum amount of data in a relatively short timeframe. The program includes the completion of localized geophysical surveys at drilling locations and surrounding areas, a detailed geophysical survey at the landfill, the collection of surface and subsurface soil, sediment, surface water, and groundwater samples for analysis, and hydrologic testing at selected monitoring wells. Analytical requirements to satisfy the data needs identified in the previous section are discussed in Section 5.2.

As a fundamental part of the field program, a field laboratory will be utilized at the areas exhibiting petroleum (BTEX) and TCE contamination to assist the field team in making informed decisions on potential sample locations. The field laboratory, as discussed in the SAP (Appendix A), will provide GC analysis of BTEX and TCE in soil samples collected in the field. Calibration of the analytical instrument will be specific for the areas being investigated, but will be primarily calibrated for compounds identified under previous investigations. The data will be used for screening purposes to provide an initial evaluation of the potential concentrations of contaminants in soil samples. All field screening methods and data will be validated by the North Pacific Division Laboratory (NPD). Selected samples will be analyzed at a project laboratory to confirm screening results and to provide data of sufficient quality to meet the DQOs of the project.

In order to assess the analytical results obtained from samples collected from each source area, a comparison to background data must be provided for the RI report. To support this effort, ADCOE is conducting a base-wide background study to establish the background soil constituents in and around Fort Wainwright. Results of this study will be used in conjunction with source area specific background sample results to interpret sample analytical results. Other documented studies relative to natural soil constituents may be used if appropriate for source area data.

The sampling program discussed in the following sections includes a thorough consideration of background samples. Guidance for collecting background samples is included in Guidance for

Data Usability in Risk Assessment (EPA 1992). The recommendation calls for planning a sufficient number of samples from representative locations such that decisions can be made in confidence about the presence or absence of contamination. At OU-4, where background levels that reflect anthropogenic activity may exist, naturally occurring constituents, such as arsenic, also are at concentrations that would otherwise approach regulatory levels of concern. The background locations identified for sample collection at each area of OU-4 will account for a statistical representation of background conditions.

Anticipated locations for the collection of surface soil, sediment, subsurface soil, (borings), and groundwater (monitoring wells) samples are indicated on Figures 5-1 through 5-3 for the Landfill, CSY, and FTPs, respectively.

5.1.2.1 Geophysical Survey

To supplement previous geophysical data (ADCOE 1992), the field investigations will include a geophysical survey of the areas in which soil borings and monitoring wells are to be completed. Two mutually complimentary techniques will be implemented. Ground penetrating radar (GPR) will be used to survey potential drilling locations for subsurface obstacles. This includes utilities and pipelines that may not be located on available maps. Prior to the initiation of drilling in locations in areas where utilities and pipelines are expected according to existing maps, the area will be surveyed to confirm the locations of these structures prior to drilling operations. Data acquired from the GPR survey also may be used to estimate the depth to the groundwater table and to characterize the permafrost depth in these areas. For confirmation of the configuration of permafrost as depicted on sounding profiles, an electromagnetic geophysical instrument (EM-31) also will be used. The EM-31 has proven valuable in confirming the presence of and estimating the depth of permafrost. The instrument will be used to confirm results obtained by the GPR, or to provide data where GPR results may not be conclusive.

A detailed geophysical survey is planned for the landfill area to characterize the subsurface and to aid in developing the local groundwater flow model, which could provide information on preferential pathways affecting contaminant transport. During previous investigations, permafrost was characterized throughout the drilled interval of monitoring wells installed adjacent to the landfill. An extensive EM survey also was performed within the southwest boundary of the landfill, which further characterized permafrost near the landfill. As described previously,

landfill heat generation from organic refuse disposal may have contributed to a thaw bulb directly beneath the landfill. Since no drilling has been conducted within the landfill, the extent of permafrost beneath the landfill is unknown. The presence of a thaw bulb may significantly influence local groundwater flow patterns. The geophysical survey of the landfill area is designed to obtain as much information as possible for characterizing the subsurface strata. The instrumentation selected for the survey must be capable of identifying multiple layers in the subsurface and penetrating capping material and refuse to reach the natural formations. To meet these needs, a combination of EM and GPR equipment will be used. The proposed survey utilizing the EM-34-3 and GPR will be conducted in the landfill characterization. Alternately and/or jointly, the time domain electromagnetic (TDEM) survey technique utilizing an EM-47 or equivalent may be employed to provide a depth-dependent profile of the landfill. A complete discussion is provided in the SAP Section 3.2. Since the subsurface medium is likely to exhibit low conductivities (refuse) overlying lower conductive permafrost, EM data alone may not be conclusive. GPR data also may be difficult to interpret given the expected variations within the refuse to refract and reflect signals as a non-homogenous layer. The techniques implemented will require adjustments in the field as data are collected and examined for usefulness.

Data obtained from the geophysical investigation will be incorporated with available data obtained from CRREL studies which may be conducted at or adjacent to the landfill area. All geophysical efforts in the landfill area will focus on characterizing the extent of permafrost that may or may not exist beneath the overburden and refuse of the landfill, or characterizing other subsurface conditions that might influence groundwater movement. The instruments identified for the landfill geophysical investigation represent the best known available technologies for providing subsurface data beneath the landfill, given the conditions that likely exist (i.e., refuse and potential permafrost). Utilization of the instruments and reduction of the data may be modified, if necessary, in an attempt to fully characterize subsurface conditions. Interpretation of the geophysical data will include a discussion of techniques attempted, as well as, techniques applied.

5.1.2.2 Surface Soil Sampling

Surface soil samples will be collected at OU-4 according to preliminary document reviews and analytical data available to date. Samples will be collected in areas with stained soils, stressed vegetation, surface drainage pathways, and where hazardous materials are known or

observed to exist. Selected surface soil samples will be screened at the field laboratory, and depending on the results, the location of subsequent samples will be adjusted appropriately for characterizing the extent of contamination. This technique will be useful particularly at the CSY and FTP areas where surface petroleum contamination can be effectively characterized in the field. An equivalent number of samples will be analyzed at the project laboratory. The general surface soil sample collection program will be conducted in the following areas.

Landfill. Surface soil samples will be collected in the landfill area to characterize potential contaminant migration pathways (i.e., drainage), to determine background conditions, and to characterize the ash material used in capping the landfill. Analytical results from these samples will be used to formulate remedial action alternatives. A total of 8 surface samples will be collected from the ash cap to characterize the ash material and 4 samples will be collected to define the physical/biological/chemical parameters to determine potential remedial design requirements. These randomly located samples will be collected where existing capping material covers closed segments of the landfill and in other areas where native surface soils have been in contact with capping materials. Surface samples for representative of background conditions will be collected at two off-site locations that have not been directly impacted by landfill activities and where surface soil/vegetation conditions are relatively similar.

Surface soil samples will be collected along the drainage at the southwest corner of the landfill and at other identified drainages. One sample will be collected at an oil spill location, if observed in the field. Additional soil samples will be collected at locations of stressed vegetation or stained soil. A total of 42 surface soil samples will be collected at the landfill including samples collected at drainages and drilling locations.

CSY. In areas where petroleum contamination has occurred, field screening for BTEX of surface soil samples will be performed to assist in characterizing the extent of BTEX contaminants. A total of 5 samples will be collected for characterizing surface soil conditions at the CSY. A total of 1 background samples will be collected in adjacent areas to determine soil conditions outside of the CSY. Since adjacent areas may be impacted by activities not related to the CSY soil sample analytical results will be carefully examined and compared to background samples collected in other areas at Fort Wainwright that exhibit similar soil/vegetation conditions. Additional screening samples may be collected in the source area to characterize contaminants that are detected during initial screening.

FTP. The surface soil sampling program at the FTPs will include sampling FTPs 3A and 3B where application of fuel materials occurred and surrounding areas where fuels may have spilled or migrated, particularly along drainage pathways. Field screening techniques for BTEX will be used to determine optimal sampling locations for samples collected for laboratory analysis. Soil samples for characterization of the drainage pathway will be collected in lowland areas or along overflow areas not directly within the drainage. In addition, sediment samples will be collected from within the drainage. A total of 53 surface soil samples are planned for characterization of the FTPs. A total of 4 surface soil samples will be collected within the areas indicated by field screening to be areas likely requiring remediation to characterize the contaminant constituents and physical/biological/chemical components for remedial action alternatives. Background surface soil samples will be collected at a total of 3 locations to characterize the natural soil constituents in adjacent, upgradient areas with similar soil/vegetation conditions.

5.1.2.3 Subsurface Soil Samples

Drilling activities will include the completion of soil borings to characterize subsurface soils in areas where subsurface soil contamination has been identified or is suspected. Soil borings will be completed utilizing a hollow stem auger for collecting split-tube samples at 5-foot intervals or more within each boring. Soil borings will be drilled and field laboratory results will be used to characterize the depth of contamination.

The groundwater aquifer within the OU-4 area south of the Chena River has been characterized (see Appendix A) as being unconfined with discontinuous areas of permafrost where confining conditions may exist. In this scenario, permafrost areas may include an unconfined shallow aquifer and a deeper confined aquifer. The nested locations will provide hydrologic data, particularly vertical conductivities, at these locations.

In the absence of permafrost, soil borings at the CSY and FTPs will continue until at least three consecutive soil samples exhibit no detectable concentrations of VOCs according to field laboratory analysis. In the event that subsurface soils analyzed at the field laboratory exhibit no detectable contamination, a sample will be collected at the bottom of the soil boring for confirmation analysis at the project laboratory. In areas where seasonal frost coexists with permafrost, drilling will continue, if possible, through seasonal frost layers to characterize soils beneath these layers. Since POL contamination has not been characterized at the landfill, field screening for

TRPH in soil samples will not be performed. However, field screening for TCE will be performed to assist in locating appropriate soil boring locations.

If groundwater is encountered, a soil sample will be collected at the groundwater interface. Depending on the area being investigated, results of field laboratory analysis, and location of the soil boring, the existing borehole may be utilized to install a monitoring well, in which case the drilled depth will be extended to the desired completion depth.

Landfill. Subsurface soil samples will be collected at a maximum of 16 locations in the landfill. Soil borings drilled around the landfill and adjacent to trench locations are likely to encounter permafrost through most of the drilled interval and, therefore, are not expected to exhibit soil contamination. Boring locations have been selected that will, to the extent possible, characterize those areas where contaminants are likely to have migrated based on data previously collected. These locations are within permafrost-free areas along the drainage southwest and east of the landfill. Locations also will be selected on the basis of field screening results where TCE contamination is identified.

The presence of VOCs in groundwater samples from landfill monitoring wells suggests that contaminants may have migrated through subsurface soils. Both in groundwater and subsurface soils, VOCs in sufficient quantities can behave as DNAPLs. Since the quantity of the compounds released to the environment is unknown, it will be assumed that DNAPL behavior is a possibility; therefore, subsurface soil samples will be collected near the top of a confining layer (i.e., permafrost) as it is encountered in each soil boring.

Soil borings also will be drilled in areas topographically upgradient of the landfill to characterize what would be background conditions for the landfill area. Identified soil borings that will be utilized for monitoring well installation below the permafrost will be completed using air rotary techniques. During these operations within the interval of permafrost, split-tube samples will be collected for examination only until a subpermafrost aquifer is encountered. Samples for analysis will then be collected through the potential screened interval.

Samples collected from split tube samples will be analyzed to characterize contaminant constituents as well as physical/biological/chemical characteristics that will be used in developing remedial action alternatives.

CSY. Subsurface soil contamination at the CSY has likely migrated vertically from the storage yard area unless confining layers are present and have limited migration to horizontal

movement. Depth of subsurface soil contamination will be identified by soil borings within the CSY area. Extent of subsurface migration of contamination will be determined by soil borings completed adjacent to the storage yard at locations selected from initial TPH field screening results and examination of sampled subsurface materials for evidence of confining layers or permafrost. A total of 7 soil borings will be drilled in the CSY, 3 of these will be completed as monitoring wells. One soil borings will be drilled in a background location to characterize subsurface soils that have not been impacted by the CSY activities. This boring also will be completed as a monitoring well.

FTPs. The FTP area is characterized by undulating topography with several lowland and drainage areas. Soil borings for collecting subsurface soil samples will be located along probable migration pathways. Soil samples collected from the surface and subsurface will be field screened for VOCs to determine where subsequent soil borings should be drilled. Soil borings will continue until field screening indicates that no VOC contamination is present. These findings will be verified through laboratory analysis. A total of 20 soil borings will be drilled in the FTP area, 13 of which will be completed as monitoring wells.

5.1.2.4 Monitoring Well Installation

As part of the characterization of the extent of contamination, evaluation of potential migratory pathways for existing contamination, and determination of appropriate remedial action alternatives, the field investigation program will include the installation of monitoring wells at selected locations. For purposes of collecting groundwater samples, 2-inch diameter wells will be installed and screened across the water table with allowance for seasonal fluctuations in the water table. Monitoring wells installed at the landfill as subpermafrost wells will be completed as 4-inch diameter wells within a water-bearing permafrost-free interval. Monitoring wells installed downgradient of a source at the FTPs will be completed as 4-inch diameter wells for potential product recovery.

In addition to these installations, piezometer nests will be installed to provide piezometric data as well as characterization of the groundwater. Piezometers will be installed, some adjacent to existing monitoring wells, to characterize piezometric conditions at the perched (super-permafrost) or unconfined aquifer screened at the water table, at the base of the aquifer where permafrost is absent, and at a screened interval below the top of the water table.

Planned monitoring wells for OU-4 include 11 wells located at the landfill, 4 wells located at the CSY, and 13 wells located at the FTPs.

5.1.2.5 Hydrologic Data

Hydrologic data will be collected at OU-4 at each of the three source areas to establish hydraulic parameters, potential contaminant migratory pathways, and provide information for reviewing remedial action alternatives. The data to be collected are discussed in the following sections.

Water Level Measurements. Following the installation and development of monitoring wells, a water level measurement program will be instituted to establish groundwater flow directions and gradients. Water levels will be measured during field activities on a daily basis from all monitoring wells and accessible domestic wells. Multiple water levels (daily) will provide data relative to short term water table trends and will reconfirm water levels from initial measurements that may appear anomalous. All water levels will be measured from a reference point (i.e., top of casing) that has been surveyed both vertically and horizontally to Alaska State plane coordinates.

Long term monitoring at selected wells will be performed by ADCOE to establish seasonal groundwater fluctuations and the effect on groundwater flow direction and gradient. Wells will be selected on the basis of relative location and appropriateness for obtaining good piezometric data. A preliminary list of wells is provided in the SAP.

Hydrologic Testing. Hydrologic testing will be performed on selected wells in the landfill area to obtain data relative to aquifer hydraulic conductivities as well as providing information specific to well performance relative to application of pump and treat remedial action alternatives.

Where appropriate, past and on-going investigation will be incorporated into the OU-4 hydraulic testing program. Data available for the floodplain aquifer (i.e., OU-3) will be used to estimate parameters at the CSY and FTPs. Slug tests will be performed at these areas to confirm approximated ranges of hydraulic values.

A combination of continuous discharge pump tests and slug tests will be performed. The pump tests will require the collection and disposal of purged water. Selection of wells to be tested and the selection of the tests to be performed will be made partially on the basis of the logistics involved with handling of purge water.

The continuous discharge pump tests will be modified as appropriate, particularly if well performance is less than anticipated. It is anticipated that a 24-hour pump test will be conducted in the landfill area, possibly using the Ski Hill snow making well. Specifics of the tests are discussed in the SAP (Appendix A). The tests will require pumping from the designated well at a constant rate while monitoring water levels and pressure variations within the pumped well and adjacent monitoring wells. Following completion of pumping, monitoring will continue until recovery in the wells is complete.

5.1.2.6 Surface Water/Sediment Samples

Surface water samples will be collected at OU-4 from the representative surface water bodies located at the source areas to determine whether contaminant migration has impacted surface waters. Samples will be analyzed for VOCs, POLs, major cations, major anions, and related parameters to establish possible groundwater to surface water pathways. The analytical parameters are specified in Section 5.1.3.1. Sediment samples will be collected at OU-4 to determine if contaminants have found in surface water impacted sediments at the site. In general, the sediment samples will be collected from the same locales as the surface water samples. Field observations will be made and noted of any obvious drainage pathways that might provide a migration pathway to other migration routes (e.g., Chena River).

Landfill. The presence of surface water depends on the amount of precipitation that has occurred during the year. Surface water samples will be collected from ponded surface water in the landfill area and along drainages. A total of 16 surface water samples will be collected in the landfill area, from the drainage ditches west and east of the landfill, from lowland areas with pooled water, and from the Chena River. Background surface water samples also will be collected from wetland areas outside of the landfill area upgradient in the Chena River. A total of 26 sediment samples will be collected including collocated shallow augered samples.

CSY. Drainage pathways adjacent to the CSY may be water-filled depending on the seasonal precipitation conditions. A total of 4 surface water/sediment samples are planned for collection at the CSY drainages. Since groundwater discharges in the cooling pond area, a total of five sediment samples will be collected to determine if contaminants have impacted sediments. Two surface water samples will be collected from the cooling pond to confirm with historical data

that the surface water contains no contaminants. In addition, 1 background surface water/sediment samples will be collected.

FTP. Surface water, particularly in wetland areas, will be sampled at the FTPs depending on the seasonal precipitation conditions. A total of 15 surface water/sediment samples will be collected at the FTPs and includes 3 background locations.

5.1.3 Sample Analysis/Data Validation

Sample analyses parameters have been designed to meet data requirements for the four categories of data use discussed in Section 4 (i.e., environmental characterization, contaminant characterization, remedial action alternatives, and risk assessment). Analytical detection limits will be established to meet DQOs defined in Section 4.1 and are provided in Table 5-1 and Table 3-1 of the QAPjP (Appendix B). A description of the analytical parameters is provided in the following sections.

5.1.3.1 Analytical Requirements

Samples will be analyzed for the parameters indicated in Table 5-1. Analytical parameters and selection criteria by matrix are described in the following paragraphs. In addition to the parameters described below, approximately 5 percent of soil/water samples submitted for hydrocarbon classification analyses also will be analyzed for Gas Range Organics (VPH-G) and Diesel Range Organics (DRO) using ADEC methods.

Surface and Subsurface Soil Samples. Surface and subsurface soil samples will be collected from each source area at OU-4. These samples will be submitted for analysis of both chemical and physical parameters.

Chemical Parameters

- VOCs, semivolatile organic compounds, pesticides/PCBs, herbicides, TAL metals, petroleum hydrocarbon classification, total recoverable petroleum hydrocarbons (TRPH), and total organic carbon (TOC) analyses will be performed on all samples to delineate the extent of contamination and provide information necessary for evaluating remedial alternatives. Ash samples will be analyzed for dioxin, pesticides/PCBs, TAL metals, and chlorinated herbicides. Dioxin analysis will be performed on samples from the CSY and FTPs.

- Nitrate/nitrite and phosphorus analyses will be performed on selected samples to provide information necessary for evaluating remedial alternatives. Approximately two to three representative samples will be analyzed from each source area to provide information for characterization, treatability studies, and selection of remedial alternatives. For subsurface soils, two to three samples will be collected from each selected soil boring for these analyses.
- Toxicity Characteristic Leaching Procedure (TCLP) extraction and analyses for VOCs and inorganics may be performed on selected samples to provide information necessary to evaluate remedial alternatives. Samples that may be analyzed using TCLP include those collected within anticipated contaminant plumes where contamination is expected to be relatively high. It is expected that one to four samples will be collected and archived for possible analyses from each facility.
- Petroleum hydrocarbons measured as BTEX will be field analyzed (except at the landfill) in soil samples. For surface soil samples, these analyses will be used in plume areas (e.g., only stained soils) to assist in characterizing the extent of petroleum contamination at OU-4 source areas and to identify samples for potential project laboratory analyses. For subsurface soil samples, these analyses will be performed at all soil boring and monitoring well locations to characterize the extent of petroleum contamination at OU-4 facilities and to screen samples for potential project laboratory analyses.
- TCE field analysis will be performed on soil and groundwater samples collected from the landfill area to assist in characterizing contamination and identifying potential sample locations. A similar analysis program will be established as with the TPH screening.

Physical Parameters

- Grain-size, Atterberg limits, specific gravity, and moisture content analyses will be performed on selected samples to characterize geological units at OU-4 source areas and to provide information necessary for the treatability study and for selecting remedial alternatives. A representative sample(s) will be collected from each area of investigation and each lithologic unit. For subsurface soils, two to three samples will be collected from each selected boring for these analyses. Ash samples will be analyzed for grain size only.

Sediment Samples

Sediment samples will be collected from each of the OU-4 source areas. These samples will be submitted for analysis of the following chemical parameters.

- VOCs, semivolatiles, TAL metals, pesticides/PCBs, herbicides, and TOC analyses will be performed to delineate the extent of contamination at selected source areas and to provide information necessary for evaluating remedial alternatives. Petroleum hydrocarbon classification and TRPH will be analyzed for in samples collected in the CSY and FTP

areas. Dioxin analysis will be performed on samples from the CSY and FTPs to determine their presence or absence.

- Sediment toxicity testing will be performed to assess the ecological impacts to fresh water invertebrates in wetland areas adjacent to the landfill.

Surface Water Samples

Surface water samples will be collected where appropriate from each of the OU-4 source areas. These samples will be submitted for analysis of the following chemical parameters.

- VOCs, semivolatiles, pesticides/PCBs, herbicides, petroleum hydrocarbon classification, TRPH, total and dissolved priority pollutant metals, and barium analyses will be performed to delineate the extent of contamination at selected source areas and to provide information necessary for evaluating remedial alternatives. For semivolatiles and total and dissolved priority pollutant metals analyses, only two surface water samples (one upstream and one downstream) will be submitted.
- Total dissolved solids, and major cations and anions analyses will be performed to provide information necessary for potential treatability studies and for evaluating remedial alternatives.
- Nitrate/nitrite and alkalinity analysis will be conducted to supply information on water quality at OU-4.
- Temperature, pH, conductivity, and oxidation-reduction potential measurements will be measured in the field at the time of sampling to provide reference information regarding water conditions.
- Surface water samples from the FTPs and the CSY will be analyzed for dioxins to determine their presence or absence.

Groundwater Samples

Groundwater samples will be collected from each facility at OU-4. These samples will be submitted for analysis of the following chemical parameters.

- VOCs, semivolatiles, petroleum hydrocarbon classification, pesticide/PCBs, herbicides, TRPH, total and dissolved priority pollutant metals, barium, and TOC analyses will be performed to delineate the extent of contamination at OU-4 and to provide information necessary for evaluating remedial alternatives.
- Total dissolved solids, and major cations and anions analyses will be performed on selected samples. Approximately one to three representative samples will be analyzed

from each source area to provide information for site characterization, treatability studies, and selection of remedial alternatives.

- Nitrate/nitrite, potassium, and alkalinity analyses will be conducted to supply information on water quality at OU-4.
- Biological oxygen demand (BOD) analysis will be performed on groundwater samples to provide information necessary for treatability studies and selecting a remedial alternative.
- BTEX and TCE field analysis will be performed on groundwater samples to aid in characterizing contamination.
- Temperature, pH, conductivity, and oxidation-reduction potential measurements will be measured in the field at the time of sampling to provide reference information regarding water conditions.
- Explosive residue analysis will be performed on samples collected from areas with residue to determine if explosives reported to be in the landfill are leaching into the groundwater.
- Dioxin analysis will be performed on samples collected from the CSY and FTPs to determine their presence or absence.

Groundwater Samples from Drinking Water Wells

Groundwater samples collected from water supply wells located near the CSY will be analyzed for the following chemical parameters.

- VOCs, semivolatile organic compounds, priority pollutant metals, and barium analyses will be performed to identify potential groundwater plumes originating from OU-4.
- Temperature, pH, conductivity, and oxidation-reduction potential measurements will be measured in the field at the time of sampling to provide reference information regarding water conditions.

Sample preparation and analysis will be performed using methods described in "Test Methods for Evaluating Solid Waste," EPA SW-846, third edition, September 1986; "Methods for Chemical Analysis of Water and Wastes," EPA 600/4-29-020, 1983; and "American Society for Testing and Materials," ASTM, 1989.

Reference methods may be impractical in some cases depending upon samples matrices. In those instances, the laboratory may substitute alternative methods, subject to ADCOE approval,

provided they are properly validated, standardized, and referenced, and are acceptable to EPA and ADEC.

The project laboratory will be expected to meet or exceed established QC limits for the methods as published by the EPA for accuracy, precision, and sensitivity. Analysis of laboratory method blanks, spiked samples, duplicate samples, and reference standards will be used to assess these parameters. In general, approximately 10 percent of the total number of samples should be collected for internal laboratory QC checks. Appropriate corrective measures, as specified in the analytical methods, will be required when QC results fall outside established control limits.

Field duplicates and blank samples will be submitted to the laboratory as external QC samples. Trip and sample equipment blanks will be analyzed to monitor field and/or laboratory contamination. Field duplicates will be analyzed to monitor both laboratory precision and field variability.

5.1.3.2 Data Validation and Reduction

The United States Corps of Engineers NPD laboratory CENPD-PE-GT-L will validate the project laboratory's sample results. The project laboratory is required to follow EPA's "Functional Guidelines for Data Validation" (EPA 1988, 1991).

All field screening data will be reviewed by methods specified by NPD. All project laboratory data generated from samples will be reviewed by comparing calibration, accuracy, and precision to the QC criteria listed in the method description (SW-846). The validation procedures are generally composed of the following steps:

- Verify that correct samples were analyzed and reported in appropriate units;
- Verify preservation and holding times;
- Verify that initial and continuing calibrations were performed and met QC criteria;
- Verify that no analytes are present in the method blanks and that one blank is run every 10 samples; and
- Verify that a duplicate and matrix spike, or matrix spike/matrix spike duplicate were run every 20 samples, and that QC criteria are in-control.

All laboratory data calculations and reductions will be performed as described in the applicable method references. Raw data (including laboratory worksheets, notebooks, sample tracking records, instrument logs, standard and sample preparation logs, calibration data, and associated QC records) should be retained by the laboratory for a minimum of 10 years and be available for inspection if necessary.

Additionally, 10 percent of the data from the investigation performed at the CSY in 1991 will be evaluated by the contractor for a Level IV data validation review.

5.1.4 Human Health Risk Assessment

Data collected for the remedial investigation at OU-4 will be used in part to establish the human health risks of the contaminants as they exist at the source areas. This section describes how the human health risk assessment will be developed.

The human health risk assessment activities for the three OU-4 source areas will be conducted in accordance with national and regional EPA guidance. The principal guidance documents for these activities are:

- Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual Part A (EPA 1989d), Part B, Development of Risk-Based Preliminary Remediation Goals (EPA 1991e), and Part C, Risk Evaluation of Remedial Alternatives (EPA 1991f);
- Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors", Office of Solid Waste and Emergency Response (OSWER) Directive 9285.6-01, March 25, 1991 (EPA 1991g);
- Guidance on data useability in Risk Assessment OSWER Directive 9285.09a (EPA 1992);
- EPA Region 10 Supplemental Risk Assessment Guidance for Superfund August 16, 1991 (EPA 1991j).

Additional guidance includes EPA's Exposure Factors Handbook (EPA 1989b), the Superfund Exposure Assessment Manual (EPA 1988), and guidance on assessing air (EPA 1990a) and groundwater (EPA 1988c).

The Region 10 supplemental risk assessment guidance divides the risk assessment activities into three phases: project planning, preliminary data analysis, and preparation of the baseline risk

assessment report. Deliverables are identified for each phase. The preparation of this work plan is the final element of the Phase I Risk Assessment activities. Other Phase I activities have included contributions to and review of the RI management plan, SAP, and QAPjP. The Phase I Risk Assessment includes:

- A preliminary CSM,
- Preliminary remedial goals, and
- A preliminary review of potential exposure scenarios and pathways.

These deliverables are provided or discussed in the next section.

5.1.4.1 Phase I Risk Assessment Deliverables

Preliminary Conceptual Site Models. The CSM were provided in Section 3 and includes a preliminary review of potential exposure scenarios and pathways. CSMs are subject to review and revision throughout the RI process as additional information becomes available.

Preliminary Remedial Goals. The primary purpose of assembling or developing preliminary remedial goals is to provide the potentially responsible parties (PRPs) and agency managers with early information on the anticipated range of risk-based concentrations that may become goals for site cleanup actions. A secondary purpose is to identify gaps in the availability of toxicological information early in the risk assessment process so steps can be taken to obtain the necessary information in a timely fashion.

The steps involved in developing preliminary remedial goals include:

- Identifying expected chemicals of potential concern (COPCs),
- Identifying potential ARARs,
- Assembling toxicological information on the expected COPCs, and
- Calculating the risks at ARARs and risk-based concentrations.

The risk assessment contractor will be required to develop preliminary remedial goals as one of their first tasks. A preliminary list of COPCs should be based on site history and characteristics and the nature of the activities carried out there. Chemicals that will probably be included

in the preliminary list of COPCs can be deduced from the information in the CSMs and previous preliminary hazard evaluations (E & E 1991aa, 1991bb). Previous studies at the landfill identified barium in the soil and ash and VOCs including trichloroethene, 1,2-dichloroethene, 1,1,2,2-tetrachloroethane, and benzene in the groundwater as COPCs (E & E 1991aa and ADCOE 1992). Previous investigations indicate that waste POLs (TRPH, oil, and grease), VOCs (benzene, trichloroethane, etc.), pesticides, and metals (lead, chromium) may be included in the preliminary list of COPCs at the CSY (ADCOE 1986; ADEC 1991; ADCOE 1991a; ADCOE 1992c). Lastly, preliminary examination of the FTPs identified benzene, toluene, xylene, lead, and zinc as probable COPCs (E & E 1991bb).

Chemical specific standards for soil, water, and air specified in federal or state regulations that may become ARARs need to be identified. These are likely to include drinking water MCLs and maximum contaminant level goals (MCLGs), ambient water quality criteria (AWQC), National Ambient Air Quality Standards, National Emissions Standards for Hazardous Air Pollutants (NESHAPs), and applicable ADEC regulations.

Toxicological information should be assembled from EPA's Integrated Risk Information System (IRIS) database (EPA 1992) and Health Effects Assessment Summary Tables (HEAST) (EPA 1991b). Additional toxicological information that may be needed to complete the risk assessment must be identified as soon as possible to allow time to obtain information from alternate sources such as Agency for Toxic Substances and Disease Registry (ATSDR).

The list of ARARs and risk-based concentrations should be calculated and tabulated using the toxicological data gathered and the methods described in Appendix I of EPA Region 10's Supplemental Risk Assessment.

5.1.4.2 Phase II Risk Assessment Activities - Preliminary Data Analysis/Site Characterization Summary

Identification of COPC. Once complete, validated data are available for the RI, a three-step analysis of the data will be conducted in order to select the final list of COPCs that will be used in the baseline risk assessment.

First, the data will be reviewed for usability in the risk assessment using the criteria recommended in Chapter 4 of Risk Assessment Guidance for Superfund - Human Health Evaluation Manual (RAGS-HHEM) (EPA 1989d) and in the data usability guidance (EPA 1992).

This step ensures that the data used in the risk assessment satisfy the applicable QA criteria and screens out data attributable to field or laboratory contamination.

Second, for naturally occurring chemicals, the results for investigative samples will be compared to those for background samples, or to background concentrations reported in the scientific literature, if site-specific background information is unavailable or inadequate. Various statistical techniques may be used in order to make the comparison of investigative data to background levels as objective as possible. The statistical techniques may include t-tests or other appropriate tests for group comparisons and/or comparison of individual sample results to the distribution of background values using statistical markers such as the upper 90th or 95th percentile or upper tolerance limit of the background concentration distribution.

Finally, if a large number of candidate COPCs remain after the first two steps, a risk-based screening procedure will be used to eliminate chemicals unlikely to contribute significantly to the site risks. The risk-based screening procedure will be as follows: the maximum concentrations of each chemical found in each medium will be identified and compared to a risk-based screening value. If the maximum water concentration of a chemical is less than the concentration corresponding to a cancer risk of 10^{-6} or a hazard quotient of 0.1, and if the maximum soil concentration is less than the concentration corresponding to a cancer risk of 10^{-7} or a hazard quotient of 0.1, the chemical will be eliminated (EPA 1991j). All other chemicals will be selected as COPCs and will be carried through the baseline risk assessment.

A preliminary list of chemicals of potential concern is provided in Table 5-2 along with the analytical method detection limits and human health risk-based concentrations (RBCs) obtained from a memorandum (October 30, 1992) of revised cheat sheet RBCs which replaces Appendix II of Region 10 supplemental guidance for Superfund. The table presents the lower of the RBC values corresponding to a 10^{-6} cancer risk value and a hazard index of 1.

The proposed MRLs are lower than the corresponding RBCs in all cases except for 1,1,2-trichloroethane, 1,2-dichloroethene, and gasoline which exceed their RBCs for water by factors of 1.25, 1.67, and 2, respectively. This indicates that the proposed MRLs are generally adequate for risk assessment purposes. In the three cases noted for which the MRLs may not be entirely adequate, the MRLs miss the risk-based target levels by relatively narrow margins; margins that fall well within the range of uncertainty associated with the chemicals' toxicity estimates. Also, the substance with the greatest exceedance is gasoline and the constituent of gasoline that drives

its toxicity estimate is benzene. Benzene concentrations will be measured separately using Method 8260 which has an adequate MRL for benzene.

Revision of the Conceptual Site Model. Once complete site characterization information is available (principally the results from the RI studies) and the final list of COPCs has been selected, the CSM will be revised as needed to reflect the actual nature and extent of contamination associated with the site. The revised CSM will include all exposure scenarios that could reasonably be expected to be complete under current or potential future land use conditions.

Selection of Exposure Pathways and Receptors for Evaluation. The potential exposure pathways and receptors identified previously will be reviewed and revised as needed. All exposure scenarios having the potential to result in significant exposure to site-derived contaminants will be evaluated in the baseline risk assessment. The potential for significant exposure to occur during various exposure duration (acute, subchronic, and chronic exposures) and the potential for exposure of sensitive subgroups such as children, the sick, or the elderly, will be considered in selecting the exposure scenarios, pathways, and receptors for evaluation.

The exposure scenarios and pathways for the areas of potential concern within OU-4 were described in some detail in Section 4 (Conceptual Site Model). There appear to be four main pathways that may need to be considered in the risk assessment. They are:

- Dermal contact and internal ingestion of surface soil contaminants by site workers and on-site visitors;
- Inhalation of vapors emanating from the soils, groundwater, or surface water by site workers or other nearby individuals.
- Ingestion, dermal contact or inhalation of groundwater contaminants by groundwater users;
- Dermal contact and incidental ingestion of surface water contaminants by individuals coming in contact with contaminant surface water.

Selection of Exposure Point Contaminant Concentration. Selection of the exposure point contaminant concentrations for use in the exposure estimation phase of the risk assessment may be done in several ways. As a general rule, actual measured contaminant concentrations in the exposure media at the exposure point will be used whenever they are available. In this case, average exposure will be estimated using the arithmetic or geometric mean concentration and the

reasonable maximum exposure will be estimated using the upper 95th percentile confidence level on the arithmetic or geometric mean concentration. Sometimes it may not be feasible or practical to measure the exposure point concentration directly, or the measured values may not be the most representative estimate of the exposure concentrations expected to occur over the exposure period or area being evaluated. In this case, modeling approaches may be used in conjunction with or in place of measured concentrations to obtain more representative exposure point contaminant concentrations estimates. The guidance provided in Section 6.5 of RAGS-HHEM (EPA 1989d) on determining exposure concentrations will be used in selecting exposure point concentrations.

Selection of Exposure Factors. Standard default exposure assumptions recommended by national and regional EPA guidance documents (EPA 1991g, 1991j) will be used when available, unless site-specific information is available that would allow more representative estimates of actual or anticipated exposures to be identified. The EPA Exposure Factors Handbook (EPA 1989b) and other literature sources may be consulted for guidance on suitable values to use for exposure factors or exposure scenarios for which no standard default guidance is available. The EPA Remedial Project Manager (RPM) and risk assessment specialist will be consulted on the selection and use of any non-standard exposure factor values.

Phase II Risk Assessment Deliverables. Risk assessment memoranda will be prepared describing: evaluation of the site characterization data, the COPCs, exposure pathways and receptors evaluated, exposure point concentrations, and exposure factor values selected, and how this information was applied to the OU-4 sites. The memoranda will describe what chemicals, toxicity values, pathways, receptors, exposure point concentrations, and exposure factors were selected for use in the baseline risk assessment. The risk assessment memoranda will be provided after the site characterization work has been completed and all of the validated data are available. These memoranda will contain, in summary form, all of the information that is usually provided in Sections 1 through 4 of the risk assessment; background, data review and selection of chemicals of potential concern, exposure assessment (selection of exposure pathways, receptors and exposure factors) and toxicity assessment (compile reference doses and cancer slope factors). The only risk assessment tasks that will remain after preparation of these memoranda will be calculation of the risk estimation and preparation of the text.

5.1.4.3 Phase III Risk Assessment Activities

Preparation of the Baseline Human Health Risk Assessment Report. There is a considerable amount of detailed guidance available on the preparation of baseline risk assessment reports for Superfund sites. The baseline risk assessment report for the OU-4 sites will be prepared in accordance with the applicable national and regional guidance. It will be organized in general accordance RAGS-HHEM (EPA 1989d) and will include:

- A brief review of the site history, environmental setting, and the relevant findings of site investigations;
- A discussion of the contaminants at the site and selection of COPCs;
- A CSM identifying the potential contaminant migration and exposure pathways, the potential receptors, and routes of exposure;
- An exposure assessment which provides quantitative exposure estimates;
- A toxicity assessment which summarizes the toxicological properties of the COPCs and provides a compilation of their quantitative indices of toxicity (reference doses and carcinogenic slope factors);
- A risk characterization which combines the information developed in the exposure and toxicity assessments to obtain quantitative estimates of the risks posed by the COPCs at the site; and
- An uncertainty analysis which identifies sources of uncertainty in the risk assessment process and assesses their impact on the risk estimates.

Risk Evaluation of Remedial Alternatives. Guidance on providing risk assessment input into the evaluation of remedial alternatives for Superfund sites has been released as parts B and C of RAGS-HHEM (EPA 1991e, 1991p). The risk assessment activities that will be required are highly dependent on the outcome of the RI and the baseline risk assessment, and the remedial alternatives identified in the FS. Since the scope of risk assessment activities that may be needed to evaluate remedial alternatives is not clear at this time, they will not be included in this Management Plan. Instead, they will be addressed in a supplemental risk assessment work plan that will be prepared when the scope of the additional risk assessment activities needed becomes clear.

5.1.5 Ecological Risk Assessment

A baseline ecological risk assessment (ERA) of the OU-4 site at Fort Wainwright, Alaska will be conducted to characterize site-related threats to the natural environment. The ERA will be used to evaluate the no-action alternative at the site. Current and future risks to ecological receptors will be determined, assuming no remedial action is taken.

The ERA will be performed in accordance with current national and regional EPA guidance for ecological assessment at hazardous waste sites. This guidance includes:

- Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual (USEPA, March 1989);
- Ecological Assessment of Hazardous Waste Sites, A Field and Laboratory Reference (USEPA, March 1989);
- Statement of Work for the RI/FS Environmental Evaluation for Superfund Sites (USEPA Region X, November 1989); and
- Framework for Ecological Risk Assessment (USEPA, February 1992).

Consistent with this guidance, the ERA will be conducted in phases. The first phase, development of the work plan, involves the following steps:

- (1) Outline of the scope of the ecological risk assessment (this section),
- (2) Collection and review of existing background information (Section 2),
- (3) Identification of data needs (Section 3),
- (4) Discussion of methodologies and assumptions for the ecological risk assessment (Section 4).

The next phase of the OU-4 ERA will be a screening-level ecological risk assessment, which includes the following components:

- (1) Site Characterization,
- (2) Hazard Identification,
- (3) Exposure Assessment,

- (4) Ecological Effects Assessment, and
- (5) Risk Characterization.

The screening-level ecological risk assessment is qualitative or semi-quantitative in nature, and as such it is based on readily available information, established criteria, and reasonable worst-case assumptions. Detailed ecological investigations are sometimes required, however, to provide greater understanding of the nature and extent of risks to ecological receptors at contaminated sites. These studies may include toxicity testing, tissue-residue analysis, or biological surveys. The need for such studies at OU-4 will be determined in part from the results of the screening-level risk assessment.

The data requirements, methods, and assumptions for conducting these risk assessment activities at the OU-4 site are described in the following sections.

5.1.6 Problem Formulation

Available information on the OU-4 site relevant to the ERA includes the following:

- Descriptive inventories of wildlife and vegetation provided by Fort Wainwright biologists;
- USFWS wetlands maps;
- Information on the presence of endangered, threatened, or rare species (Federal and State) provided by USFWS and ADEC;
- Information on the location of wildlife sanctuaries, fisheries, or other protected/regulated habitats in the vicinity of the site provided by federal, state and local agencies;
- Previous investigations of site contamination, as described in the draft CSM (E & E 1992).

The first step in the ERA is to compile and review this information. Based on the review, a preliminary conceptual site model is developed as described in the following section. The information presented below will be included and expanded upon in the ecological assessment report under the problem formulation section as described in Framework for Ecological Risk Assessment (EPA 1992a) and bulletins of the ECO update series.

Conceptual Site Model

A draft CSM for the OU-4 RI/FS is included in Section 4. Information provided in that document and other available information relevant to the ERA is summarized, below.

Contaminant Types and Sources. COPCs for impacts to ecological receptors at the site include:

- BTEX (benzene, toluene, ethylbenzene, and xylene)
- DNAPLs (TCE and TCA)
- Other petroleum hydrocarbons and fuel components, and
- Barium and other metals.

Contamination at the site is derived from surface or subsurface fuel spills and incineration, leaking aboveground and underground storage tanks, and landfilling operations. Distinct source locations under investigation in the RI/FS include the following:

- (1) Landfill,
- (2) Power Plant CSY, and
- (3) FTPs.

Affected Media. Contaminants may affect soil, groundwater, air, and surface water and sediments at various locations at the OU-4 site.

- Soils - Soil contamination may occur in subsurface and surface horizons of permafrost as well as permafrost-free soils. Soils in some areas near facilities are bare, whereas most soils adjacent to the facilities are vegetated with native plants. Soil contaminants available for uptake by biota at the site may occur in particulate, dissolved or gaseous forms.
- Groundwater - Groundwater is generally not considered an exposure medium for ecological receptors. However, because groundwater may discharge to surface water bodies, groundwater contamination could pose a threat to ecosystems at the site.
- Air - Release of contaminants from surface soil could affect local air concentrations in habitats adjacent to source areas.

- Surface water and sediments - The major surface water body potentially affected by site contaminants is the Chena River. Some of the wetlands bordering the facilities may contain standing water, which could also be affected by site contaminants.

Migration Pathways. Major potential migration pathways of concern for impacts on ecological receptors at the OU-4 site include:

- Discharge of groundwater contamination to surface water bodies;
- Transport in surface runoff or air from contaminated facility areas into surrounding uplands, streams and wetlands;
- Migration of contaminants in surface water and sediment;
- Migration through the food chain.

Fate Mechanisms. COPCs at the site exhibit varying tendencies to persist in the environment and bioaccumulate in the food chain. The volatile organic hydrocarbons (BTEX and DNAPLs) tend to volatilize and degrade rapidly, and they are not expected to significantly bioaccumulate in the food chain or adsorb to sediments. Less volatile fuel components may bioaccumulate in some aquatic organisms, but they also tend to degrade and dissipate over longer time periods. Metals are a highly persistent contaminants and some may bioaccumulate in the food chain.

Ecosystem Components. Fort Wainwright site is located within the Boreal Forest ecosystem of central Alaska. The following describes general regional characteristics of the vegetation and wildlife. Site-specific characteristics are described to the extent possible with the available information.

- Vegetation. Forest communities of the region are dominated by white spruce on well drained soils and river bottoms, and black spruce on poorly drained muskeg. Interspersed with the spruce are a few other trees and tall/medium shrubs including paper birch, quaking aspen, tamarack, junipers, alder, and willows. Other common shrubs at Fort Wainwright include prickly rose, blueberries, currants, Labrador tea, and spirea. Bryophytes and lichens are abundant in some habitats. Local patterns of vegetation are affected by topography, natural disturbances such as fire, and soil conditions such as permafrost. Wetlands are abundant in the area and include treed bogs (muskeg) dominated by black spruce, and scrub shrub bogs. Boreal wetlands are characterized by acidic, nutrient poor, peat substrates with low productivity. Habitats identified in the Fort Wainwright vegetation inventory

include: muskeg, white spruce forests, black spruce forests, poplar forests, riparian thickets, sub-alpine and alpine tundra, moist tundra, successional shrublands, sedge tussocks, sphagnum bogs, and gravel bars.

- Fish and Wildlife. Wildlife typical of central Alaska occur at or near Fort Wainwright. The Fort Wainwright wildlife inventory lists 36 species of mammals including moose, black bear, numerous species of small mammals (voles, lemmings, shrews), weasels, mink, muskrat, red fox, beaver, and porcupine. The Fort Wainwright bird inventory lists 141 species of birds including waterfowl, raptors, and songbirds. Wetlands adjacent to the landfill area are used by nesting and migrating waterfowl. Fort Wainwright is located within the Tanana River anadromous fish watershed. The Chena River, a major tributary of the Tanana River, flows less than 1 mile from the Landfill, CSY, and FTPs. The Chena supports several species of salmon as well as other fish and numerous species of benthic invertebrates.
- Endangered, Threatened and Rare Species. The only known endangered species in the area are peregrine falcons, with nesting grounds located approximately 12 miles southwest of Fairbanks (USFWS 1991).

Ecological Receptors and Exposure Pathways. Numerous species of plants, fish and wildlife could potentially be exposed to site contaminants at the OU-4 source areas. Exposure of organisms to contaminants could occur as a result of uptake from soil, air, surface water and sediments, and food chain pathways. No information is currently available to assess the nature and extent of this potential exposure. However, based on the general ecological characteristics of the site, organisms vulnerable to contaminant exposure at the OU-4 facilities include:

- Organisms in surface water and benthic environments including fish and benthic macroinvertebrates;
- Soil-dwelling and burrowing organisms such as soil invertebrates and small mammals;
- Plants such as spruce, shrubs, and herbaceous species growing near source areas;
- Large herbivores such as moose;
- Organisms higher in the food chain such as raptors, piscivorous birds, or carnivores.

Ecological Endpoints. Ecological endpoints to be considered for Superfund investigations are generally characterized as "assessment endpoints" or "measurement endpoints". As described in Ecological Assessment of Hazardous Waste Sites. A Field and Laboratory Reference (USEPA, March 1989), assessment endpoints are "formal expression of the environmental values that are to be protected" from impacts of site contaminants. A measurement endpoint "is a measurable environmental characteristic that is related to the valued characteristic chosen as an assessment endpoint", or "a quantitative expression of an observed or measured effect of the hazard". For example, an assessment endpoint for the OU-4 source areas may be that the water quality in the Chena River will not adversely affect salmonid populations. If the potentially affected reach of the Chena River is established as a potential salmonid spawning area, either through a background check of historical and/or current records or through observations made during the ecological reconnaissance, an appropriate measurement endpoint for this assessment endpoint would be COPC exposure point concentrations in the spawning areas of the Chena River sediments. In this example, assessment of risk would involve comparison of Chena River sediment exposure point concentrations for the COPCs with known salmonid egg no observed effect levels (NOELs) for the COPCs. Salmonids are described for illustrative reasons only: other fish species may be selected if appropriate. Measurement endpoints suitable for evaluating this assessment endpoint are the published LC-50s or NOECs for effects of COPCs on representative salmonid species.

Since it is impossible to account for all of the species in the ecosystems potentially affected by the site, a few representative indicator or target species will be chosen for evaluation in the ERA.

Indicator species will be selected in a manner consistent with EPA guidance (EPA 1991d). The factors that will be considered include the following:

- Relative bioavailabilities of the COPCs to candidate species;
- Relative species sensitivities to the COPCs;
- Relative exposure potentials of candidate species to the COPCs;
- Relative lengths of residence times in the various media of the potentially affected habitats; and
- Relative values placed on the candidate species by society.

Potential assessment endpoints include the survival, growth, reproduction, population abundance, and community structure of the selected indicator species. Published toxicity values will be used as measurement endpoints to evaluate these assessment endpoints (see Section 4).

In addition, toxicity testing of sediments collected from wetlands adjacent to the landfill will be conducted using fresh water invertebrates. The toxicity testing will follow ASTM protocols as described in Standard Guide for Conducting Sediment Toxicity Tests with Fresh water Invertebrates (ASTM E 1383-90). Possible measurement endpoints include survival, growth, and reproduction.

5.1.7 Identification of Data Needs

Data needs for the ERA include the following:

- Descriptive physical and ecological data to characterize habitats and receptors at the site, such as vegetation and wetlands descriptions and maps, wildlife species inventories, ecological surveys and studies, soil surveys, climatological data, topographical maps, and aerial photographs;
- Measured or estimated concentrations of COPCs at ecologically relevant locations such as the Chena River and wetlands adjacent to the Landfill source area. Ecologically relevant locations refers to areas that are suitable, or are potentially suitable, to support indicator species;
- Wetlands in the potentially affected area should be evaluated for their functional values (i.e., their values as a wildlife habitat) for pollution abatement, and for flood control using the ADCOE 1987 manual; and
- Information on physical properties of sediment (e.g., particle size and total organic carbon), and surface water (e.g., hardness, dissolved oxygen, pH, and conductivity).

The data needs identified above will be satisfied by collection and evaluation of available site data and further field data collection efforts for the RI/FS. Consistent with the phased approach, the proposed RI ecological investigations are limited to a review of available data, an ecological reconnaissance survey, wetland sediment toxicity testing, and sampling of soil, surface water and sediment for COPCs, within or adjacent to potentially impacted habitats. If the screening-level risk assessment indicates potential risks to biota, however, further data collection will likely be

necessary to evaluate the significance of ecological impacts at the site, or to monitor the effectiveness of cleanup actions taken to protect human health and the environment.

5.1.8 Methodologies and Assumptions

The following is a general summary of methods and assumptions for the ERA. The particular methods and assumptions chosen for the ERA will depend on the types of contaminants, affected media, and receptors chosen for evaluation. Therefore, methods will be refined as additional information becomes available from the RI/FS. However, tentative assumptions and methodologies for each element of the ERA are discussed in the following five sections. It should be noted that there is no detailed EPA guidance for developing ecological risk estimates from RI/FS data. Hence, the methods and assumptions chosen for the OU-4 ERA will rely on the best professional judgement of the risk assessors, subject to the consensus of representatives of regulatory agencies with jurisdiction at the site.

Site Characterization

The Site Characterization will provide a summary of the physical and biological characteristics of the site. The relevant aspects of area climate, geology, soils, and land use will be summarized. The nature and composition of the biotic communities potentially affected by the site will be described. An inventory of important habitats and species in the site vicinity will be compiled, including wetlands and endangered, threatened and rare species. A general cover-type map identifying important habitats in the site vicinity will be prepared.

A site reconnaissance will be conducted by a field biologist to provide confidence in the characterization. The survey will be concentrated within a 0.5 mile radius of each of the four source locations identified in Section 2.2. A 0.5-mile radius was chosen for this screening-level ERA, based on professional judgement and experience with similar hazardous waste sites, as a distance within which potential effects, if present, could reasonably be expected to be observed. The reconnaissance survey will include:

- Verification of mapped wetland boundaries and assessment of wetland functions and values (following standard procedures as presented in agency wetland delineation manuals);

- Meander survey to identify major vegetation cover-types and to qualitatively assess the suitability of each cover-type for wildlife;
- Survey of benthic macroinvertebrates in the Chena River adjacent to and upstream from the Landfill, and description of aquatic habitat features such as substrate, flow, and bank characteristics (following standard methods as presented in Rapid Bioassessment Protocols for Use in Streams and Rivers, USEPA, May 1989).

Hazard Identification

Hazard Identification consists of identifying and screening contaminants and media for further evaluation in the ERA. According to the EPA Region X guidance Statement of Work for the RI/FS Environmental Evaluation for Superfund Sites (USEPA Region X, November 1989), reasons for deleting chemicals from the ERA include but are not limited to:

- Chemicals not detected above risk-based detection or background levels;
- Absence of plausible exposure pathways for ecological receptors;
- Low frequency of occurrence in environmental media.

Risk-based levels for screening chemicals in surface water include the EPA Ambient Water Quality Criteria and analogous ADEC criteria. Comparative soil and sediment criteria and background levels are published in a variety of sources, although national criteria for soils and sediments are not yet available. Examples of available published sources of toxicity threshold values are The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program (Long and Morgan 1991); The Provincial Sediment Quality Guidelines (MOE 1990) for sediments; and the Registry of Toxic Effects of Chemical Substances (RTECS 1981-82) for dermal contact with, ingestion of, and inhalation of soil-sorbed contaminants.

Exposure Assessment

Exposure assessment quantifies the current and future exposure of ecological receptors to COPCs. It includes the following components:

- Analysis of contaminant release, migration and fate;
- Derivation of exposure point concentrations in media of concern;

- Identification and characterization of exposure pathways for selected ecological receptors;
- Derivation of Estimated Exposures (EEs) from estimates of contaminant uptake and accumulation rates for ecological receptors.

Exposure point concentrations will be estimated from measured or estimated concentrations in environmental media for surface water sediment, soil, air, and food chain exposure points. The average and maximum levels of each contaminant will be used to derive exposure point concentrations for various locations and habitats at OU-4. Contaminant uptake and accumulation factors will be derived from sources such as the USFWS Biological Report Series, AWQC documents, EPA's Acquire database, and RTECS (1981-82). Safety factors will be applied to published toxicity thresholds based on professional judgment and published precedences such as Menzie et al. 1992, Nabholz 1991, and EPA 1984.

Exposure scenarios for current and future exposures at the OU-4 site will be developed to evaluate the ecological receptors and endpoints identified in Section 2.2.

Exposure pathways will then be evaluated by estimating contaminant uptake and accumulation rates for ecological receptors. The result of this analysis will be a quantitative estimate of reasonable maximum and mean EEs for each of the selected receptors. For aquatic species, the surface water exposure point concentrations will be used as EEs. Sediment exposure point concentrations of nonionic organics will be normalized for sediment organic carbon content, to allow calculation of sediment pore water concentrations to be used as EEs for benthic organisms (Briefing Report to the EPA Science Advisory Board on the Equilibrium Partitioning Approach to Generating Sediment Quality Criteria, USEPA April 1989).

Food chain EEs will be derived using uptake factors, bioaccumulation factors, and intake rates expected for each receptor species, based on published information. Food chain EEs can be expressed as dietary residues (mg/kg diet), doses (mg/kg body wt/day), or tissue residues (mg/kg tissue wt).

Ecological Effects Assessment

Available ecotoxicological data will be reviewed to derive relevant toxicity information for each of the COPCs. Toxicity Benchmark values (TBs) for critical endpoints will be selected for

the most sensitive species. The TBs will represent doses or ambient concentrations of contaminants associated with particular adverse effects on biota. Sources of toxicity information include the scientific literature, USEPA or ADEC standards and criteria, USFWS contaminant reviews, and computer databases such as AQUIRE and RTECS.

Values will be derived from the best available data and, if necessary, multiplied by safety factors following accepted risk assessment methods. The selected or calculated TBs will account for the adverse effects of chronic exposure to COPCs (i.e., the TBs will represent the expected chronic NOEC or NOEL for each endpoint).

A brief toxicological profile will be provided for each of the COPCs, summarizing their known toxicity, modifying factors, distribution and fate in the environment, and available criteria.

Potential ecological effects will also be evaluated from the results of sediment toxicity tests. Significant impairment of invertebrate growth, reproduction, or survival will be evaluated with regard to concentrations of contaminants at the same locations.

Risk Characterization

Risk characterization involves the quantitative and qualitative determination of the potential for adverse ecological effects at the site. Risk is quantified by calculating a hazard index (HI) which is the sum of individual hazard quotients (HQs) for functionally similar measurement endpoints, i.e., measurement endpoints associated with the same assessment endpoint (EPA 1989). HQs are calculated as the ratio of estimated exposure concentrations to the toxicity benchmark value for each measurement endpoint:

$$HQ = EE / TB$$

If $HQ > 1$, a risk of adverse effects is presumed for the evaluated pathway.

Risks are characterized qualitatively through assessment of the magnitude, duration, spatial extent, potential for recovery, and uncertainties of risks associated with contamination at the site. Current and future risks at the population, community, and ecosystem levels are discussed.

The risk assessment will conclude with a summary of risks and uncertainties, and an interpretation of the ecological significance of site-related risks.

5.2 FS TASKS

The FS will consist of three tasks:

- Remedial alternative development and screening;
- Detailed analysis of alternatives; and
- FS Reports.

Each of the tasks is described in the following sections.

5.2.1 Remedial Alternatives Development and Screening

5.2.1.1 Identification of Remedial Action Objectives and General Response Actions

As the first step in the development of remedial alternatives, COPCs, media of interest, exposure pathways, and remediation goals for the protection of human health and the environment will be specified. The objectives will address the following general goals.

- Adequate protection against ingestion of or contact with contaminated soils;
- Adequate protection against future ingestion of or contact with contaminated groundwater;
- Arresting the growth and/or reducing the size of the groundwater plume(s);
- Adequate protection against contact with airborne contaminants, either as vapors or dust.

The remedial action objectives will be based both on the recommendations of the health-risk assessment as well as all chemical- and location-specific ARARs.

5.2.1.2 General Response Actions

General response actions describe the classes of actions that will satisfy the remedial action objectives. They are used for organization and classification purposes in the subsequent identification/selection of remedial technologies. General response actions may include treatment, containment, excavation, extraction, and institutional actions. Like remedial action objectives, general response actions are medium-specific.

5.2.1.3 Identification and Screening of Remedial Technologies

Using the results of field investigations conducted during the RI and earlier investigations, technically feasible technologies to mitigate the observed contamination will be identified, so that the remedial action objectives may be met. Technologies will be identified and screened for each established general response action.

In general, applicable remedial technologies will be selected on the basis of their effectiveness, implementability, and cost. Each of these criteria are discussed below.

- Effectiveness. This criterion addresses both the potential effectiveness of the technologies in handling the estimated amounts of contaminated media and in meeting the goals identified in the remedial action objectives, as well as the potential impacts to human health and the environment during the construction and implementation phase. Furthermore, it considers how proven and reliable the process is with respect to remediating the identified contaminants of concern.
- Implementability. This criterion addresses both the technical and administrative feasibility of implementing each technology considered. Technical implementability is used as an initial screen of technology types and process options to eliminate those that are clearly unworkable at a site. Processes requiring prohibitively extensive permitting from government agencies may also not be selected.
- Cost. Cost will not be used as a major factor in the selection of technologies; however, cost will be a factor in choosing between technologies that can produce similar levels of remediations with equivalent implementability.

Through the identified screening process, the number of potentially applicable technologies will be narrowed to those most appropriate to remediate the contamination at OU-4.

5.2.1.4 Development of Remedial Alternatives

Technologies identified for each medium will be combined as appropriate to create remedial alternatives. The remedial alternatives may address soil and groundwater as a single system reflecting the interaction between these media, or may address each medium separately to allow additional flexibility in the alternative analysis and remedy selection process. Between four and six alternatives (or three to five alternatives for each medium if addressed separately) will be developed. Included among these alternatives will be alternatives that contain the contaminated media, treatment alternatives, and the no-action alternative.

5.2.2 Detailed Analysis of Alternatives

A detailed analysis will be conducted of the alternatives developed. This analysis will provide the relevant information needed for the selection of a site remedy. The first step of the detailed analysis will be to provide a specific description of each remedial alternative. Each description will provide the details necessary for implementation of the alternative and describe ancillary activities that would be required. The description will provide comment on the size and configuration of the representative process option, time for remediation, rates of flow or treatment, spatial requirements, distance for disposal, and required permits. All action-specific ARARs would be identified at this point.

In the next step of the detailed analysis, each alternative will be assessed against the nine evaluation criteria. The results of this assessment will then be arrayed to compare the alternatives and identify the key differences among the options.

Criteria by which the alternatives will be assessed include:

- Overall protection of human health and the environment;
- Compliance with ARARs;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume;
- Short-term effectiveness;
- Implementability;
- Cost;
- State acceptance; and
- Community acceptance.

These criteria are discussed in detail in the following subsections.

5.2.2.1 Overall Protection of Human Health and the Environment

This criterion will provide a final check to assess whether each alternative provides adequate protection of human health and the environment. The overall assessment of protection draws on

the assessments conducted under the other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Evaluation of the overall protectiveness of an alternative will focus on whether a specific alternative achieves adequate protection and will describe how site risks posed through each pathway being addressed by the FS are eliminated, reduced, or controlled through treatment, engineering, or institutional controls. This evaluation will allow for consideration of whether an alternative poses any unacceptable short-term or cross-media impacts.

5.2.2.2 Compliance with ARARS

This evaluation criterion will be used to determine whether each alternative will meet all of its federal and state ARARs that have been identified in previous stages of the RI/FS process. The detailed analysis will summarize which requirements are applicable, relevant, and appropriate to an alternative and will describe how the alternative meets these requirements.

5.2.2.3 Long-Term Effectiveness and Permanence

The evaluation of alternatives under this criterion will address the results of the remedial action in terms of the risk remaining at the facility after response objectives have been met. The primary focus of this evaluation will be the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. Such an evaluation is particularly important to containment and disposal alternatives.

5.2.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

This evaluation criterion will address the regulatory preference for selecting remedial actions that employ treatment technologies which permanently and significantly reduce toxicity, mobility, or volume of contaminants. This preference is satisfied when treatment is used to reduce the principal risks at a site through destruction of the contaminants, reduction of the total mass of contaminated media, or irreversible reduction in mobility.

5.2.2.5 Short-Term Effectiveness

This evaluation criterion will address the effects of the alternative during the construction and implementation phase until remedial response objectives are met. Under this criterion, alterna-

tives will be evaluated with respect to their effects on human health and the environment during implementation of the remedial action.

5.2.2.6 Implementability

The implementability criterion will address the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation.

5.2.2.7 Cost

Detailed cost analysis of the selected remedial alternatives will include the following steps:

- Estimation of capital, operations and maintenance (O&M), and institutional costs;
- Present worth analysis; and
- Sensitivity analysis.

5.2.2.8 State Acceptance

This assessment will evaluate the technical administrative issues and concerns the State of Alaska may have regarding each alternative.

5.2.2.9 Community Acceptance

This assessment will evaluate the issues and concerns the public may have regarding each alternative.

5.3 REPORTING

This section describes the documents to be submitted during the RI/FS process for OU-4. A schedule of submittals as defined in the FFA is discussed in the next section. The reporting requirements for OU-4 include key document submittals that include:

- Management Plan for data collection that specifies work plan requirements for field investigations, sampling, analyses, QA/QC, and data evaluation for the purposes of developing a detailed RI, risk assessment, and FS;

- Site Specific Community Relations Plan that addresses the "right-to-know" aspects of OU-4 and will serve as a component to an area-wide community relations plan;
- Applicable, Relevant, and Appropriate Requirements review that considers state and federal regulations relative to the contaminants identified in the environmental media at OU-4;
- Remedial Investigation Report summarizing the data collected, defining the nature and extent of contamination and providing a baseline human health and ecological risk assessment;
- Feasibility Study Report that reviews remedial action alternatives and specifically details viable options in terms of attainment of cleanup goals, cost, and implementability; and

Data presented in the RI report will include reference maps that incorporate the most updated information with regard to existing facilities, topography (i.e., USGS), and physical features observed in the field. In addition to the documents listed above, the RI/FS process also will require routine reporting on review meetings conducted during the process, documentation of the comment resolution on draft document submittals, and monthly progress reports summarizing activities performed, as well as planned activities for the next reporting period.

Table 5-1

**SAMPLE ANALYTICAL PARAMETERS
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA**

Parameter	Matrix	Method	Quantitation Limit ^a
Gas Range Organics VPH-6	Surface soils, subsurface soils, sediments, surface water, groundwater (excluding drinking water).	SW-846 Modified Method 8015 ⁽ⁱ⁾	5.0 mg/kg soil 0.1 mg/L water
Diesel-Range Organics (DRO)	Surface soils, subsurface soils, sediments, surface water, groundwater (excluding drinking water)	Method AK.102 ⁽ⁱ⁾	4.0 mg/kg soil 0.1 mg/L water
VOCs	Surface soils, subsurface soils, sediments, surface water, groundwater	SW-846 ^b Method 8260, EPA-DW ^c 524.2 (drinking water samples).	5-100 µg/kg soils; 5-100 µg/L water; 0.02-0.35 µg/L drinking water
Semivolatile Organic Compounds (+ tetrahydrofuran-landfill groundwater)	Surface soils, subsurface soils, surface water, sediments, groundwater	SW-846 Method 8270 EPA-DW ^c 525 (drinking water samples)	330-1,600 mg/kg soils; 10-100 µg/L water; 0.01-15 µg/L drinking water
Inorganics		SW-846 Method 6010/7000 Series soils EPA 200 Series water ^e	Pb 10 mg/kg soils; Pb 0.05 µg/L water; all other quantitation limits are method dependent.
Petroleum Hydrocarbon Classification	Surface soils, subsurface soils, sediments, surface water, groundwater (excluding drinking water well samples)	SW-846 Modified Method 8015 ^d	0.1-1.0 mg/kg ^d soils; will vary for water
Pesticides/PCBs	Subsurface soils, sediments, groundwater, surface water, surface soil	SW-846 Method 8080; EPA Method 608; EPA-DW Method 505	Soil: 1-50 µg/kg Water: .025-1.0 µg/L Drinking Water (approx): .01-15 µg/L
Dioxin	Subsurface soils, surface soil, groundwater, sediments, surface water, ash	SW-846 Method 8290	Ash, soil 1.0-200 ng/kg Water: .01-2 ng/L
Chlorinated herbicides	Subsurface soils, sediments, groundwater, surface water, surface soil	SW-846 Method 8150	water: .5-249 µg/L Soil: .5-249 mg/kg
TOC	Surface soils, subsurface soils, sediments, surface water, groundwater (excluding drinking water well samples)	9060 EPA 415.1 ^f	Will vary for soils; 1 mg/L water
TRPH		EPA 418.1 ^g	10 mg/kg soils; 1 mg/L water
Sediment Toxicity	Sediments	ASTM E 1383-90	NA

Table 5-1

**SAMPLE ANALYTICAL PARAMETERS
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA**

Parameter	Matrix	Method	Quantitation Limit ^a
Grain Size	Surface soils, subsurface soils, sediment (grain size only)	ASTM D421, D422 ^e	1.001 mm soils
Atterberg Limits		ASTM D4318 ^e	NA
Specific Gravity of Soil Solids		ASTM D854 ^e	NA
Moisture Content		ASTM D2216 ^e	NA
Nitrate/Nitrite	Surface soil, subsurface soil,	EPA 353.2 ^g	-0.25 mg/kg
Phosphorous		EPA 365.2 ^g	Will vary
Dissolved Inorganics	Surface water (excluding potassium), groundwater (excluding drinking water well samples)	EPA 200 Series ^g	Pb 0.05 µg/L; all other quantitation limits are method dependent.
Potassium		SW-846 Method 7610	0.01 mg/L
Alkalinity		EPA 310.1 ^g	NA
Total Dissolved Solids		EPA 160.1 ^g	10 mg/L
Major Cations/Anions (Dissolved)		I-1472-85 ^f I-2058-85 ^f	0.01-0.1 mg/L
Temperature	Surface water, groundwater, drinking water	SOP	NA
pH		SOP	NA
Conductivity		SOP	NA
Oxidation-Reduction Potential		SOP	NA
Biochemical Oxygen Demand	Groundwater (excluding water well samples)	EPA 405.1 ^g	NA
BTEX	Surface soils; Subsurface soils, groundwater (excluding drinking water well samples)	Field Portable Gas Chromatography SOP ^h	5 mg/kg/50 µg/L
TCE			5 mg/kg/50 µg/L
Explosives Residue	Groundwater (landfill only)	SW-846 Method 8330	.03-12 µg/L
TCLP	Surface and subsurface soils	Extraction by SW-846 Method 1311	See Method Detection Limits (SW-846)

Table 5-1 (Cont.)

BTEX - Benzene, Toluene, Ethylbenzene, Xylenes
NA - Not Applicable
Pb - Lead
SOP - Standard Operating Procedure
TCE - Trichloroethene
TCLP - Toxicity Characteristic Leaching Procedure
TOC - Total Organic Compound
TRPH - Total Recoverable Petroleum Hydrocarbon
VOC - Volatile Organic Compound

- ^a Quantitation limits may be adjusted for sample weight and sample dilution. Quantitation limits are typical, attainable method quantitation limits. Actual laboratory reporting limits may differ from those listed.
- ^b Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.
- ^c Methods are contained in EPA "Methods for the Determination of Organic Compounds in Drinking Water," EPA-600/4-88/039, December 1988.
- ^d The modification to Method 8015 will be specified by the project laboratory prior to field investigations. Accuracy, objectives, and detection limits will be determined by the project laboratory.
- ^e Methods are contained in American Standards for Testing Materials (ASTM).
- ^f Methods are contained in EPA-USGS 146 Decision Memorandum, September 12, 1989.
- ^g Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, revised March 1983.
- ^h Method will be provided by A/E contractor in an SOP prior to field investigations.
- ⁱ Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska
- ^j ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

Table 5-2				
COMPARISON OF RISK-BASED CONCENTRATIONS AND METHOD REPORTING LIMITS FOR SOIL AND WATER				
Chemical (Preliminary Chemicals of Potential Concern)	Water ($\mu\text{g/L}$)		Soil (mg/kg)	
	M.R.L.	RBC	M.R.L.	RBC
Method 8260				
Benzene	0.5	0.8(a)	5	20(a)
Toluene	0.5	1,000(b)	5	50,000(c)
Ethylbenzene	0.5	2,000(b)	5	30,000(c)
Xylenes	0.5	800(b)	5	500,000(c)
Trichloroethene	0.5	3(a)	5	60(a)
cis-1,2-dichloroethene	0.5	400(b)	5	3,000(c)
trans-1,2-dichloroethene	0.5	700(b)	5	5,000(c)
Method 7060 Soil/EPA 206.2 Water				
Arsenic	1.0	0.05(a)	0.5	80(b)
Method 8080 Soil/608 Water				
Endrin	0.1	10(b)	.005	80(b)
Method 8015				
Gasoline	100	50(f)	10	380(f)
JP-4	100	6,200 (f)	10	22,000(f)
JP-5	100	1,500(f)	10	5,500(f)
Diesel fuel	100	620(f)	10	2,200(f)
Method 7421 soil/239.2 water				
Lead	1.0	15(e)	0.5	500(d)
Method 6010 Soil/200.7 Water				
Barium	10	3,000(b)	2	20,000(b)
Cadmium	5	20(b)	0.5	100(b)

(a) Risk = 10^{-6}

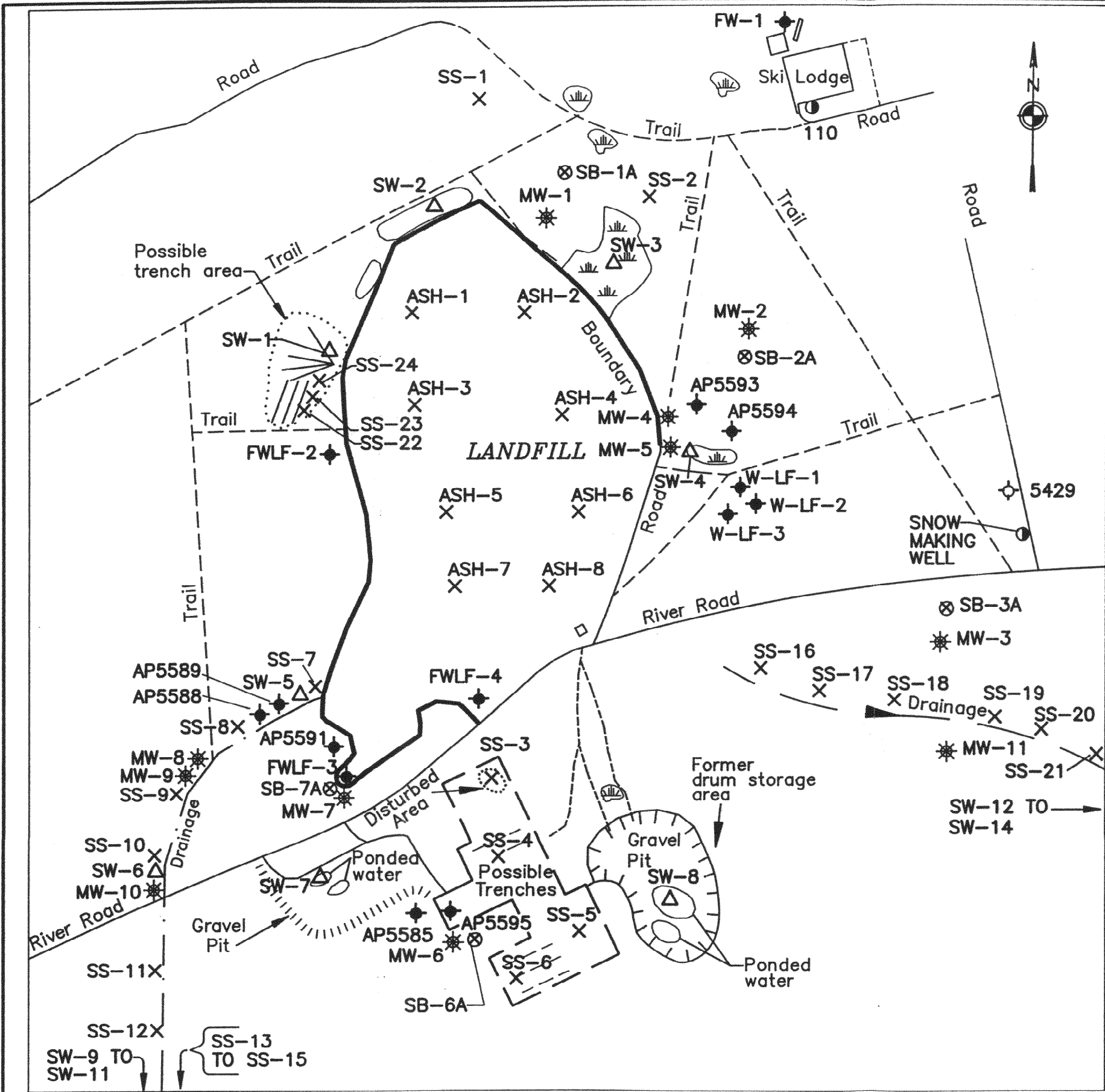
(b) Hazard Index = 1

(c) Hazard Quotient = 1

(d) OSWER Directive 9355.4-02a

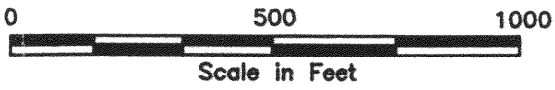
(e) Action level in lieu of MCL

(f) Based on provisional RPDs and SFs

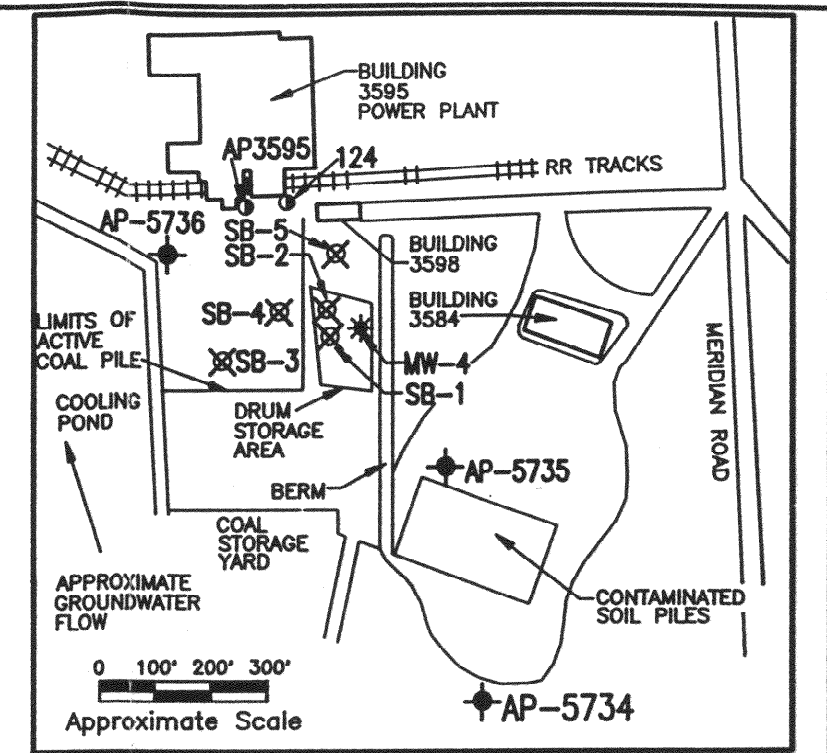


LEGEND

- Marshy area
- Existing well location
- Existing piezometer
- Proposed monitoring well location/soil boring/surface soil sample
- Existing supply well
- Surface soil sample
- Surface water / sediment sample
- Soil boring / surface soil sample (SB-2A INDICATES AN ALTERNATE LOCATION, IF REQUIRED FOR INSTALLING A SUBPERMAFROST MONITORING WELL)
- SURFACE SOIL SAMPLES SS-25 TO SS-28 WILL BE TAKEN FROM REMEDIAL ACTION AREAS TO BE DETERMINED IN THE FIELD. SURFACE SOIL SAMPLES SS-29 TO SS-33 WILL BE TAKEN AT AREAS OF STRESSED VEGETATION OR STAINS DETERMINED IN THE FIELD.
- THE LOCATION OF BACKGROUND SAMPLES SW-15 AND SW-16 TO BE DETERMINED IN THE FIELD.










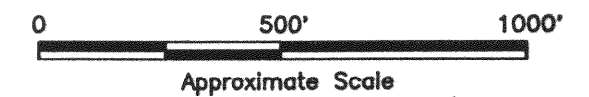
DEPARTMENT OF THE ARMY			
ALASKA DISTRICT, CORPS OF ENGINEERS ANCHORAGE, ALASKA			
DESIGNED:	FAIRBANKS, ALASKA		
DRAWN: EGM	FORT WAINWRIGHT, OPERABLE UNIT 4		
TRACED:	LANDFILL		
CHECKED: LD	PROPOSED SAMPLING		
SUBMITTED:	LOCATION MAP		
CHIEF			
RECOMMENDED:	RECOMMENDED:	DATE: 04-21-93	
CHIEF	SECTION	CHIEF, ENGINEERING DIVISION	
DRAWING NUMBER		SCALE:	
KPQ5-1.DWG		PLATE NUMBER	
		FIGURE 5-1	



INSET "A"

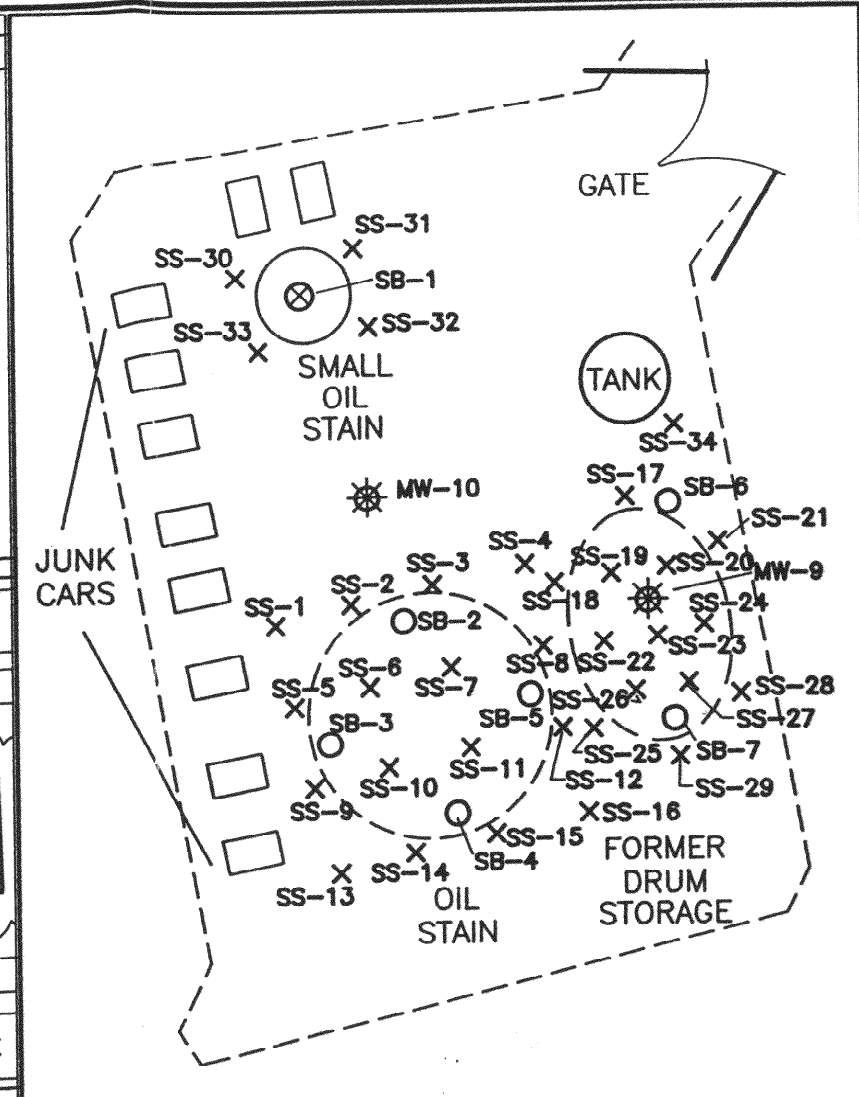
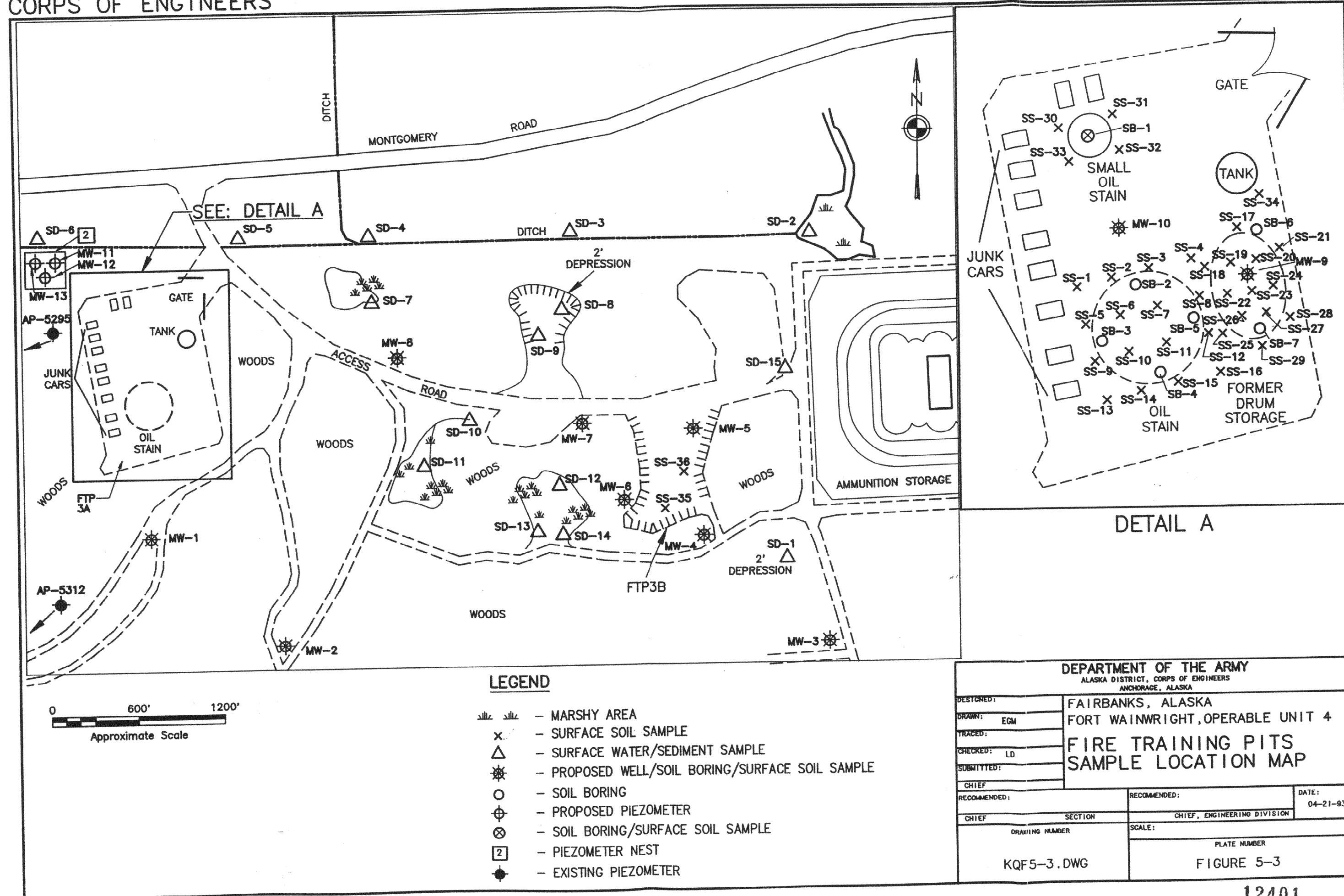
LEGEND

-  — EXISTING MONITORING WELL
 — EXISTING SUPPLY WELL
 — PIEZOMETER NEST
 — SURFACE WATER/SEDIMENT SAMPLE
 — SOIL BORING/SURFACE SOIL SAMPLE
 — PROPOSED WELL/SOIL BORING/
SURFACE SOIL SAMPLE
 — RAILROAD



<p align="center">DEPARTMENT OF THE ARMY ALASKA DISTRICT, CORPS OF ENGINEERS ANCHORAGE, ALASKA</p>			
DESIGNED:	<p align="center">FAIRBANKS, ALASKA FORT WAINWRIGHT, OPERABLE UNIT 4 POWER PLANT COAL STORAGE YARD SAMPLE LOCATION MAP</p>		
DRAWN: EGM			
TRACED:			
CHECKED: LD			
SUBMITTED:			
CHIEF			
RECOMMENDED:		RECOMMENDED:	DATE:
			04-21-93
CHIEF	SECTION	CHIEF, ENGINEERING DIVISION	
DRAWING NUMBER		SCALE:	
KQF5--2.DWG		PLATE NUMBER	
		FIGURE 5-2	

C:\CORP\KQ5200\KQF5-2 APR.21,1993



6. SCHEDULE

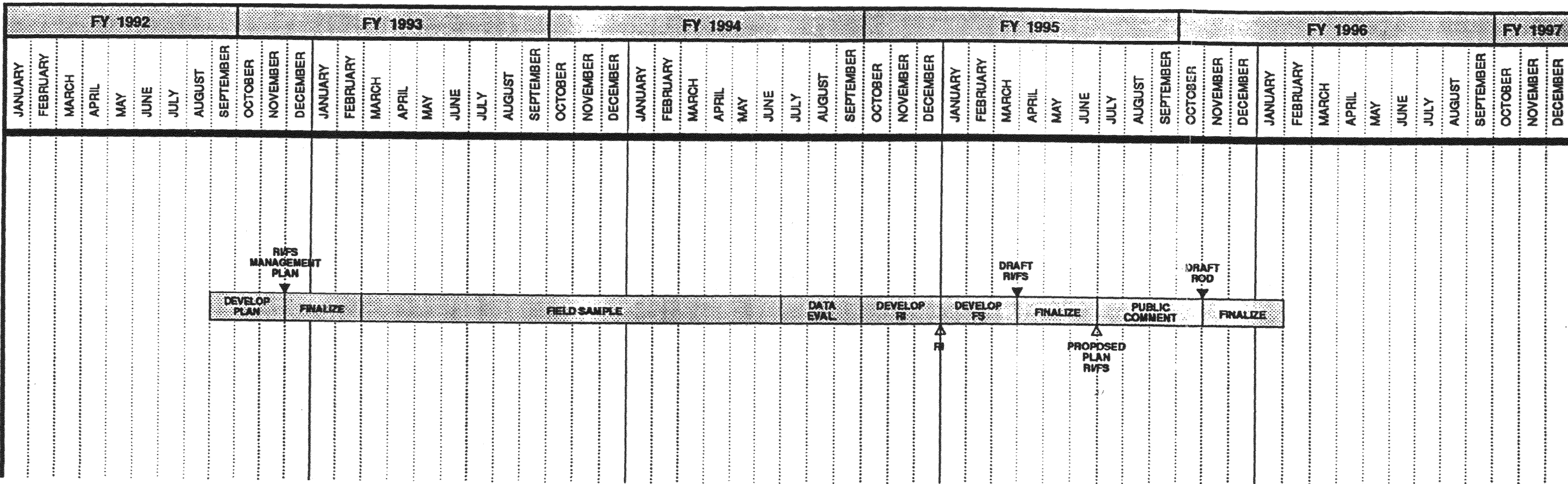
The overall RI/FS process is guided by the schedule set forth in the FFA that includes milestones for the completion of field activities and sampling as well as draft and final document submittals. The defined milestones in accordance with the FFA are listed below and are graphically presented on the timeline in Figure 6-1.

Primary Documents	
Draft RI/FS Management Plan	December 1, 1992
Draft RI/FS Report	April 1, 1995
Record of Decision	November 1, 1995
Remedial Action Plan	Not Defined
Secondary Documents	
Health and Safety Plan	December 1, 1992
Initial Identification of ARARs and TBCs	December 1, 1992
Draft RI Report	January 1, 1995
RI/FS Proposed Plan	July 1, 1995

Upon approval of the Management Plan, a field-specific schedule will be developed that identifies all field investigation activities and field teams. The schedule will address sample collection and anticipated sample deliveries to the designated laboratory(s) as well as data validation.

FT. WAINWRIGHT OPERABLE UNIT 4

----- 1992 ----- 1993 ----- 1994 ----- 1995 ----- 1996 -----



LANDFILL, POWER PLANT COAL YARD,
FIRE TRAINING PITS

DEPARTMENT OF THE ARMY ALASKA DISTRICT, CORPS OF ENGINEERS ANCHORAGE, ALASKA			
DESIGNED: L. DIEDIKER	FAIRBANKS, ALASKA FORT WAINWRIGHT SCHEDULE		
DRAWN: A. SHOWERS			
TRACED:			
CHECKED: L. DIEDIKER			
SUBMITTED:			
CHIEF	SECTION	RECOMMENDER:	DATE: 10-7-92
CHIEF	SECTION	CHIEF, ENGINEERING DIVISION	
DRAWING NUMBER 1528CH.CDR KQ5901		SCALE: N/A PLATE NUMBER FIGURE 6-1 SHEET OF	

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Appendix A
SAMPLING AND ANALYSIS PLAN

**SAMPLING AND ANALYSIS PLAN
FOR
OPERABLE UNIT 4
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

April 1993

Prepared for:

**UNITED STATES ARMY CORPS OF ENGINEERS
ALASKA DIVISION
ENGINEERING PROJECT MANAGEMENT
ENGINEER DISTRICT
P.O. Box 898
Anchorage, Alaska 99506**



ecology and environment, inc.

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1. INTRODUCTION

This Sampling and Analysis Plan (SAP) has been developed for Operable Unit 4 (OU-4) at Fort Wainwright (Figure 2-1 of the Management Plan) under orders from the United States Army (Army), 6th Infantry Division (Light), Directorate of Public Works (DPW) and pursuant to United States Army Corps of Engineers, Alaska District (ADCOE), Contract DACA85-91-D-0003, Delivery Order No. 20.

Fort Wainwright was included on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (NPL) in March 1990. A Federal Facility Agreement (FFA) for Fort Wainwright was signed by the Army, the United States Environmental Protection Agency (EPA), and the Alaska Department of Environmental Conservation (ADEC). As a result, a remedial investigation (RI)/feasibility study (FS) has been initiated for operable units defined in the FFA. This work is being conducted under the authority of CERCLA with funding provided through the Army Corps of Engineers Installation Restoration Program.

This SAP is a component of the Management Plan for OU-4 and was prepared according to Office of Solid Waste and Emergency Response (OSWER) specifications for RI/FS field sampling plans. The plan has been developed based upon the analysis of OU-4, conclusions drawn in the conceptual site model (CSM) (Section 3), and the defined data quality objectives (DQOs). These sections have been developed, in part, from review of documents and data compiled during previous investigations and summarized in the Management Plan. A brief summary of the aforementioned OU-4 analysis and CSM conclusions is provided; however, the primary focus of this document is the sampling investigation.

The goals and objectives of the SAP follow:

- Determine the sources of previously identified contamination;
- Define the nature and extent of surface and subsurface soil contamination;

- Delineate groundwater contaminant plumes;
- Collect sufficient hydraulic information to predict the direction and rate of future groundwater contaminant migration;
- Determine relevant groundwater/surface water relationships as they pertain to each source; and
- Collect sufficient data to evaluate remedial action alternatives and to implement interim remedial actions.

The overall sampling strategy is to:

- Identify permafrost-free areas, using a geophysical survey, to select drilling locations;
- Sample surface and subsurface soils in areas of known and suspected contamination;
- Install and sample monitoring wells in locations suspected to have groundwater contaminant plumes;
- Sample surface water and sediments where there is suspected contaminant migration via groundwater seeps or overland flow;
- Define the hydraulic parameters of the potentially affected aquifers; and
- Define the physical parameters of the contaminated soils.

Following a background information review, an ecological reconnaissance at OU-4 will be conducted, as described in Section 5.1.8 of the Work Plan, to include the following:

- Wetland assessment,
- Cover type and wildlife habitat survey, and
- Rapid bioassessment benthic survey in the Chena River.

Based on observed field conditions, potential interim remedial actions (IRAs) and removals may be identified. Should IRAs be recognized during the RI, appropriate notification will be given to the Alaska District.

The following sections detail the media-specific sampling strategies.

1.1 MEDIA-SPECIFIC SAMPLING STRATEGIES

The media to be sampled during the OU-4 RI/FS include surface soil, subsurface soil, groundwater, surface water, sediment, and air. General sampling strategies are described below. The potential contaminants of concern include metals; pesticides; polychlorinated biphenyls (PCBs); volatile organic compounds (VOCs); base neutral/acid semivolatile organic compounds (semivolatile); petroleum hydrocarbons; petroleum, oil, and lubricants (POLs); and dioxins.

Field screening for VOCs will be conducted on soil and water samples identified in this SAP and any additional samples deemed appropriate to assist in characterizing the extent of contamination and refining sample locations (i.e., soil borings and monitoring wells).

1.1.1 Surface Soil

The goal of the surface soil investigation is to identify the nature and extent of contamination in surface soils, background concentrations of relevant natural soil constituents, and potential migration pathways. Soil samples will be collected from areas of visibly stained soil or stressed vegetation and areas where there is suspected contamination and will be analyzed to determine the quantity of contamination, as well as the presence or absence of contaminants. Field analytical techniques will be used to the maximum extent possible for further characterizing specific areas.

Source-specific sampling rationale are included in Section 2. Surface soil sampling methodologies are described in Section 5.1.

1.1.2 Subsurface Soil

The subsurface soil investigation has been designed to characterize the nature and extent of subsurface contamination. The investigation will be conducted to define contaminant plumes and potential contaminant migration pathways. Subsurface soil samples will be collected from soil borings and borings for monitoring well installation.

Determination of sampling locations will be guided in part by results from rapid turnaround field analyses. Field analytical techniques can be used to rapidly analyze a large number of samples, and provide real-time data to aid in determining the optimum boring and monitoring well locations. Field analysis also will aid in the selection of samples to be forwarded for more comprehensive fixed laboratory analysis.

Each sample will be characterized for lithology, analyzed using field analysis techniques, and, if appropriate, shipped for analysis at the project laboratory. Source-specific sampling

rationale are included in Section 2. Subsurface soil sampling methodology and drilling procedures are described in Section 5.2.

1.1.3 Groundwater

The purpose of the groundwater investigation is to identify contaminant plumes and potential contaminant migration pathways. Using the field analytical results from subsurface soil samples, monitoring wells will be installed in locations where contaminated subsurface soil is identified. These locations will be selected to determine if groundwater at the location is contaminated and to define the extent of the potential contaminant plume. In areas where contamination may not exist monitoring well locations will be placed as indicated in the SAP. Locations designated for monitoring wells also will be sampled in accordance with the subsurface soil sampling scheme discussed previously.

To identify the nature and extent of groundwater contamination, an understanding of groundwater movement beneath potential contamination sources is necessary. Review of the CSM and other sources of regional information indicate that the current system of groundwater monitoring wells installed at OU-4 is incomplete and, therefore, unable to provide this information. Piezometer nests will be installed to determine local vertical components of groundwater flow as well as to provide data about the regional groundwater flow pattern. A piezometer nest consists of three wells completed next to one another which are screened at different depths to provide an indication of the vertical groundwater flow component at that location. The three wells include a water table monitoring well with a screened interval spanning the range of groundwater fluctuations, and two piezometers with relatively short screen intervals (i.e., 2 feet) completed at different depths (one shallow, one deep). Depth to groundwater data collected from these wells will provide the hydraulic potential of their particular depth of completion. Previously completed ADCOE wells, such as in the Power Plant Coal Storage Yard (CSY) area, may be utilized in the piezometer nests. A two-well nest for the CSY, and a three-well nest for the FTPs are planned.

An estimated 38 new monitoring wells and/or piezometers will be constructed and installed at OU-4. Construction of wells and piezometers is described in Section 4. Specific installation locations may be changed in the field, based on field analytical data from the subsurface soil investigation. Sampling methodologies are described in Section 5.3.

1.1.4 Surface Water/Sediment

The surface water investigation will be conducted to determine whether contaminant migration has impacted surface water bodies. Surface water samples will be analyzed to identify concentration and extent of contamination, and to identify a number of characteristics including major cations and anions and related parameters to assist in determining the hydrologic connection between groundwater and surface water. Rationale for these parameters is discussed in Section 2.

Sediment samples will be collected to determine whether sediments in potential surface water body receptors have been impacted by contaminant migration. Sediment samples will be collocated with surface water samples in areas where surface water is present. Sediment samples will be analyzed for contaminant constituents to determine concentration and extent of contamination. Surface and sediment sample locations and rationales are described in Section 2. Sampling methodologies are described in Sections 5.4 and 5.5.

1.1.5 Ash

Ash samples will be characterized to identify the nature of contamination in the ash. Ash samples will be collected from the landfill and will be analyzed to determine if contaminants are present. In the event that ash is encountered at the CSY in subsurface soils, it will be sampled and analyzed using the procedures described for subsurface soil samples.

Source-specific ash sampling rationale are included in Section 2. Ash sampling methodologies will follow the same guidelines as the surface and/or subsurface soil sampling methodologies described in Section 5.1.

1.1.6 Air

The goal of the air investigation is to identify the nature and occurrence of any airborne contamination that may exist at OU-4, background concentrations of relevant natural air constituents, and potential air migration pathways. Air samples will be collected from the landfill and any other additional areas identified as having potential for airborne contaminants and will be analyzed to determine the presence or absence of contaminants.

Source-specific sampling rationale are included in Section 2. Air sampling methodologies are described in Section 5.6.

1.2 PLAN ORGANIZATION

The SAP is divided into nine sections. Sampling rationale and sampling locations are discussed in Section 2. Sections 3, 4, and 5 outline the methodologies for the geophysical investigation, monitoring well construction and installation, and sampling, respectively. Field laboratory procedures are detailed in Section 6. Sections 7 and 8 discuss sample documentation and handling, and data validation. References are included in Section 9.

2. SOURCE AREA INVESTIGATIONS

The source area investigations have been designed to fill data gaps outlined in the CSM and DQOs (Sections 3 and 4 of the Management Plan). The CSM and DQOs identify data required to complete a CERCLA Phase 1 risk assessment, to evaluate remedial action alternatives, and to supplement the present understanding of the sources. Data gathered during the field investigation will be used to address the data gaps and to re-evaluate the CSM.

OU-4 is discussed in terms of its three source areas: the landfill, the CSY, and the fire training pits (FTPs) depicted on Figure 2-1. The primary contaminants of concern at all three source areas include POLs, metals, pesticides, herbicides, PCBs, VOCs, and semivolatiles.

Surface and subsurface soils, groundwater, surface water, sediment, and air samples will be collected and analyzed for the contaminants of concern. Analytical and physical parameters were selected based upon the data needs and DQOs. Total organic carbon (TOC) analysis will be conducted on all sample media to assist in evaluating remedial alternatives. Other analytes were selected based upon the characteristics of the source area; however, at each source a subset of soil (surface and subsurface) samples will be analyzed for nitrates/nitrites and phosphorus to assess the feasibility of bioremediation for those soils. These same soil samples will be submitted for semi-volatiles and Target Analyte List (TAL) metals analysis to provide information necessary to fully characterize the site, and samples will be archived for possible Toxicity Characteristic Leaching Procedure (TCLP) analysis to assist in evaluating remedial alternatives. In addition, Atterberg limits, specific gravity, moisture content, and grain size tests will be conducted on soils from each source area to provide data necessary to evaluate remedial action alternatives.

Surface water and groundwater samples will be analyzed for volatiles, semivolatiles, POLs, total and dissolved priority pollutant metals and barium, nitrate-nitrite, and phosphorus to characterize contamination and assist in assessing remedial alternatives. Water samples will be analyzed for total dissolved solids, major cations and anions, and alkalinity to provide data

necessary to determine water quality. In addition, conductivity, pH, temperature, and oxidation-reduction (redox) potential will be measured to provide baseline water condition documentation. Groundwater will also be analyzed for potassium and biological oxygen demand (BOD) to provide information necessary to select remedial action alternatives.

The following sections describe the sampling program for each source area. Included is the sampling rationale, sampling locations, and analyses to be performed. Source area descriptions are included as they are relevant to the sampling investigation. For detailed source area descriptions and contaminant histories, refer to Section 2 of the Management Plan.

2.1 LANDFILL

The landfill source area includes Fort Wainwright's active landfill, located north of River Road, and the area located immediately south of River Road, which was identified in aerial photographs from 1972 as containing trenches. For descriptive purposes, the active landfill will be referred to as the landfill and the area south of River Road will be called the former trench area.

The source area is located approximately 1 mile north of the main cantonment area and covers approximately 20 acres. The source area is located within a relatively level flood plain on the northern side of the Chena River, which flows 1,500 feet away at the closest point. Birch Hill, which rises to 1,100 feet above mean sea level (MSL) lies north of the source area. Wetlands border the source area to the north and east and a black spruce forest borders its other sides, except in areas that have been cleared for access to the landfill. The former trench area is covered by an approximately 20-year boreal forest. Gravel quarry pits border the former trench area on the west side.

Well logs indicate that the source area is underlain by between 6 to 20 feet of silt and sandy silt which is underlain by at least 76 feet of unconsolidated sand and gravel outwash deposits. Terrain conductivity surveys indicate permafrost is almost continuous around the source area; however, the area north of the landfill has not been surveyed and there are permafrost-free areas on the east side and southwest corner of the landfill. Existing permafrost extends to a depth of at least 76 feet, but exhibits discontinuities locally. The active layer is estimated to be 7 to 10 feet thick (E & E 1991).

Currently, the landfill is operating under State of Alaska Solid Waste Permit No. 9131-BA007. Operations began at the landfill by the 1950s and it is currently the only active landfill at

Fort Wainwright in the main cantonment area. In the 1940s, the landfill was excavated for gravel.

Other landfills were operational at the base until 1950s. The other landfills closed by the late 1950s and this landfill received all wastes generated at the base from that time on except chemical warfare or radioactive materials. Wastes that could have been disposed in the landfill include human waste, household refuse, waste POLs, hazardous wastes, pesticides, asbestos, construction debris, and inert munitions (Kerns 1992a). Records of types and amounts of wastes disposed were not maintained.

Aerial photographs from the 1960s and 1970s indicate trenching or clearing present on the northwest and east sides of the landfill. The trenches on the east side have since been covered by materials deposited in the landfill. It is not known what was disposed in these trenches (Kerns 1992a).

Little is known about the contents of former trench area. Signs that had previously been posted in the area state "covered wet garbage trenches" (Short 1993).

Samples collected in 1985 from two of four monitoring wells surrounding the landfill were reported to contain pesticides (endrin and toxaphene) and high concentrations of metals (lead and manganese) (WCC 1990). The pesticide results were questioned on the basis of quality assurance (QA) criteria. Additional wells were installed and groundwater samples analyzed in successive sampling efforts but no evidence was found to validate the earlier report of pesticide contamination (E & E 1991). However, the 1989 groundwater samples analytical results for manganese exceeded the secondary drinking water standards in all samples (WCC 1990) and all groundwater samples collected in 1991 from the source area contained levels of iron and manganese in excess of secondary maximum contaminant levels (MCLs) (ADCOE 1991).

The results of the 1990 and 1991 groundwater sampling events indicated that groundwater in the vicinity of the landfill is contaminated with certain VOCs and metals in excess of primary and secondary MCLs for drinking water; however, there are no drinking water wells near the landfill (there is a nonpotable source at the landfill). Soils and sediments collected from areas surrounding the landfill contained elevated levels of metals, some of which are naturally occurring. Surface water in wetlands surrounding the landfill contains concentrations of metals that exceed drinking water MCLs. Coal ash, which is used as landfill cover material, contains concentrations of barium that exceed the risk-based concentrations for ambient air (E & E 1991).

The sampling strategy is described below. Sample locations are provided on Figures 2-2, 2-3, and 2-4.

2.1.1 Surface Soil

Surface soil sampling during the 1990 sampling event occurred on the western boundary of the landfill. Near-surface samples were collected from the shallow boreholes drilled west and south of the source area. VOCs and metals were detected in these samples (see Section 2 of the Management Plan). Surface soils contained levels of barium and cadmium above the normal range for soils in the western United States (Bowen 1979; E & E 1991; Shacklette 1984). Toluene, tetrachloroethene, and o- and p-xylenes were detected in near-surface soils (E & E 1991). No background levels for metals in local surface soil have been established.

Further surface soil sampling is needed because no samples have been collected in the area where surface water runoff from the landfill would likely be concentrated, in the drainage swales southwest of the landfill and southeast of the former trench area. In addition, the fill material for the former trenches has not been characterized.

2.1.1.1 Sampling Locations/Rationale

Contaminants may have migrated to the surrounding surface soils via wind or surface water erosion. Although wind erosion is a factor of concern, surface water transport is likely to be more concentrated in certain areas and, therefore, easier to trace. Since the landfill ranges from 20 to 30 feet above grade, surface water is likely to runoff in almost any direction. There is, however, a drainage swale in the southwest corner of the landfill known to contain water seasonally. There are also two reported drainages closer to the northwest corner of the landfill. In addition, an oil spill was reported in the general area. In addition, a drainage southeast of the former trench area reportedly contains water intermittently.

A total of 44 surface soil samples will be collected. Sampling will occur in two background locations, at the former trenches, the drainage swale in the southwest corner of the landfill, and at locations potentially contaminated where remediation may be considered.

Two background samples (SS-1 and SS-2) will be collected upgradient of the landfill. The concentrations of naturally occurring constituents in these samples will serve as a basis of comparison to determine the contribution of metals, specifically, from the landfill cover to the contamination of the surroundings.

Four surface soil samples (SS-3 through SS-6) will be collected from the former trench area to determine the nature of the material used to fill the trenches.

Surface water is known to flow in the drainage swale at the southwest corner of the landfill at certain times of the year. Contaminants entrained in surface water runoff could be deposited in the drainage swale. The drainage swale eventually drains into the Chena River. The sampling objective in the drainage swale is to determine the extent of potential contamination. Surface soil or sediment samples (SS-7 through SS-15) will be collected at regular intervals from the landfill downgradient in the drainage swale to the Chena River depending upon whether the drainage is dry or contains water. Surface soil samples (SS-16 through SS-21) will be collected at regular intervals from the drainage swale south of River Road, southeast of the landfill, to the Chena River. Sediment samples will be collected if the drainage contains water.

Samples (SS-22 through SS-24) will be collected from the reported surface drainages and the oil spill area located on the west side of the landfill.

Four surface soil samples (SS-25 through SS-28) will be collected in an area where remedial activities are likely to occur in order to obtain data on the physical, chemical, and biological properties of the soil to evaluate the area for treatability studies.

A maximum of five samples (SS-29 through SS-33) will be reserved for sample collection in locations where surface soils are visibly stained or vegetation is stressed.

Surface soil samples will also be collected from each of the monitoring well locations MW-1 through MW-11.

2.1.1.2 Analytical Parameters

All surface soil samples will be analyzed for VOCs, semivolatiles, TAL metals, pesticides, and TOC. Selected surface soil samples will be analyzed for the physical, chemical, and biological parameters (discussed in Section 5.1.3 of the Management Plan) needed for engineering analysis. Samples will also be collected and archived from these select locations for possible TCLP analyses. Analytical parameters, sample containers, preservation, and QA/quality control (QC) for surface soil samples are summarized in Table 2-1.

2.1.2 Subsurface Soil

Subsurface soil samples from the 1990 E & E field investigation contained VOCs and metals (see Section 2 of the Management Plan). The leachability of these contaminants was not

analyzed. All the soil boring samples contained concentrations of metals but the contaminant level could not be determined since background levels had not been established (E & E 1991).

VOCs were detected at low concentrations in samples collected at both 1 and 40 feet. Total 1,2-dichloroethene, trichloroethene, and toluene were detected in the soil sample from borehole location AP-5589 at a depth of 20 feet. Toluene was detected in AP-5590. One shallow borehole drilled near the former trench area contained xylenes (E & E 1991).

Metals concentrations were similar in all subsurface soils from various areas around the landfill. In general, metals were detected in the average range for soils in the western United States (E & E 1991; Shacklette 1984). However, certain subsurface soil samples contained mercury and cadmium in concentrations higher than the normal range for western United States soils (Bowen 1979; E & E 1991; Shacklette 1984).

Additional subsurface samples will be collected in order to assess the potential contaminant plumes at the southwestern corner and on the eastern side of the landfill and to determine the potential contribution of naturally occurring metals in groundwater. Background subsurface samples are needed to establish a statistical basis of comparison to determine levels of metals contamination and to determine if there is any other source for the contamination found in the wells on the eastern side of the landfill which are, in general, hydraulically upgradient of the landfill.

2.1.2.1 Sampling Locations and Rationale

Subsurface soil contamination has been documented at the source area. Additional subsurface sampling will aid in the delineating of the extent of contamination and define background conditions. A maximum of 16 soil borings will be drilled at the landfill; 11 will be completed as monitoring wells. Soil borings will be drilled upgradient of the landfill, in the permafrost-free areas southwest and east of the landfill, in the wetlands, and through the permafrost south and east of the source area (see Figure 2-3).

Two soil borings are proposed for each well identified for installation in the subpermafrost alluvial aquifer. Drilling will follow those guidelines specified in Sections 4 and 5.2. Only one soil boring will be drilled if groundwater is encountered within the planned depth of 200 feet below ground surface (bgs). Drilling will not continue if groundwater is not encountered within 200 feet bgs or if bedrock is encountered before groundwater. The 200-foot maximum drilled depth was selected on the basis of drill rig capabilities and expected aquifer depths. Environmen-

tal drilling operators are capable of attaining depths of 200 feet bgs on a routine basis. However, deeper depths require careful consideration of equipment, well materials, and drilling techniques. The aquifer anticipated to lie below permafrost or the interval of typical water supply installations is expected to be encountered within a 200-foot drilled depth. The second soil boring will be drilled only if groundwater is not encountered in the initial soil boring. The second soil boring will be made in a location more likely to encounter groundwater based on the geology encountered during the initial phases of the drilling program. Subsurface soil samples will be collected at the monitoring well/soil boring locations according to methodology and field screening, discussed in Section 5.2. A maximum of two subsurface soil samples per borehole will be collected to send to the project laboratory.

The upgradient boreholes will probably have to be drilled through permafrost since there are no known permafrost-free areas upgradient of the landfill. A maximum of six soil borings will be drilled in background locations; three will be completed as wells (MW-1, SB-1A, MW-2, SB-2A, MW-3, and SB-3A). These locations have an unknown thickness of permafrost. The soil borings will be drilled to groundwater, probably below the permafrost. MW-1 and possibly SB-1A will be located immediately north of the landfill to provide background subsurface soil information from above and below the permafrost. If groundwater is not encountered in MW-1 within 200 feet bgs, then the soil boring will be abandoned and the drill rig will be moved to a similar upgradient location. SB-1A will be drilled in the new location. If groundwater is not encountered within 200 feet bgs, then the soil boring will be abandoned. Otherwise, the well will be installed. Analytical results from MW-1 (and SB-1A) will be used to define background conditions. MW-2 and possibly SB-2A will be drilled between wells AP-5593 and AP-5594, and the wells at the Birch Hill Ski Lodge. The same procedure as described above will be followed. Analytical data from the soil boring(s) will aid in determining whether there is a source other than the landfill for the toluene, trichloroethene, and 1,1,2,2-tetrachloroethane detected in wells AP-5593 and AP-5594. MW-3 and possibly SB-3A will be located south of River Road and east of the former trench area. Information derived from the drilling of these soil borings will further define the extent and depth of permafrost in the source area and will establish upgradient conditions south of River Road. Samples will be collected from each soil boring drilled at 5-foot intervals until permafrost is encountered, even if it is not completed as a monitoring well.

MW-4 will be drilled to groundwater in the permafrost-free area immediately east of the landfill. MW-5 will be drilled to 200 feet adjacent to MW-4. Samples will be collected at 5-foot

intervals from these soil borings. Groundwater contamination has been documented in this area, but the source is uncertain. Analytical results from samples collected at these soil borings will provide information to determine if the landfill is the source of the contamination.

A maximum of four deep soil borings will be drilled in areas topographically downgradient of the landfill and former trenches. MW-6 and possibly SB-6A will be drilled adjacent to AP-5595; MW-7 and possibly SB-7A will be drilled adjacent to well FWLF-3. These soil borings will be drilled to the aquifer underlying the permafrost. If groundwater is not encountered in the first soil boring within 200 feet bgs, then the soil boring will be abandoned and the drill rig will be moved to a similar geological location. The second soil boring will be drilled in the new location. If groundwater is not encountered within 200 feet bgs, then the soil boring will be abandoned. If it is encountered, the well will be installed. In either case, a conductor casing (see Section 4) will be installed in the event that a confining layer is encountered (i.e., permafrost). Data gathered from the drilling of the soil borings and the sample analytical results will aid in defining the potential contaminant migration pathways above and below the permafrost, and specifically, in determining if leachate is present below the permafrost.

MW-8 and MW-10 will be drilled to the water table in the permafrost-free drainage swale southwest of the landfill and completed as wells. MW-9 will be drilled to 200 feet, adjacent to soil boring MW-8. Samples will be collected from these soil borings at 5-foot intervals. The drainage swale is suspected to act as a hydraulic conduit from the landfill. Analytical results from subsurface soil samples collected from these soil borings will help define the potential presence of a contaminant plume. Analytical results from the deep soil boring will aid determining the extent of potential dense non-aqueous phase liquids (DNAPL) (see Management Plan).

MW-11 will be drilled to groundwater in the drainage southeast of the landfill, if the drainage proves to be permafrost-free during the geophysical survey. If the drainage is permafrost-free, it may act as conduit for contaminant migration from both the landfill and the trenches south of River Road. If drainage contains permafrost, this boring will be relocated to a location to be determined in the field. Samples will be collected at 5-foot intervals.

2.1.2.2 Analytical Parameters

All subsurface soil samples from the soil boring locations will be analyzed for VOCs, semivolatiles, TAL metals, pesticides, and TOC. Selected subsurface soil samples will be analyzed for the physical, chemical, and biological parameters discussed in Section 5.1.3 of the

Management Plan needed for engineering analysis. In addition, samples will also be collected and archived from these selected locations for possible TCLP analyses. Analytical parameters, sample containers, preservation, and QA/QC for subsurface soil samples are summarized in Table 2-2.

2.1.3 Surface Water/Sediment

All three surface water samples collected from the wetlands in the 1990 E & E sampling effort exceeded secondary MCL standards for iron and manganese (see Section 2 of the Management Plan). One of the surface water samples exceeded the primary MCLs for silver. Low levels of the pesticides were also detected (E & E 1991). Since the wetlands are environmentally sensitive areas, additional surface water samples will be collected to evaluate the effect of the potential contaminants on the wetland vegetation and wildlife.

Other areas known to contain surface water during periods of the year have not been sampled in previous sampling efforts. These include the drainage swales originating in the southwest corner of the landfill and south of River Road and the ponds west of the former trench area. Both drainage swales drain into the Chena River.

Subsurface sediment sampling is needed at the wetlands to determine if contaminants are leaching to the subsurface soils. A single sediment sample collected during the 1990 sampling event contained metals at concentrations which are in the high range for western United States soils (E & E 1991, Shacklette 1984). Although the organic material and silts that compose wetland bottoms have high cation exchange capacity and tend to adsorb metal and organic contaminants; samples should be collected and analyzed to assure that there is no subsurface migration of contaminants.

2.1.3.1 Sampling Location/Rationale

Surface water runoff from the landfill or former trench area may pool in wetlands or ponds surrounding the source area. If contaminants are entrained in the runoff, they may remain in suspension or settle out and deposit in the sediments. The objective of surface water/sediment sampling is to determine the true extent of contamination.

Surface water/sediment samples will be collected from 16 locations within wetlands, drainage swales, and ponds surrounding the source area as well as from the Chena River and a background location (Figure 2-4). The number of samples will be dependent upon the presence of water. Four surface water samples (SW-1 through SW-4) will be collected from four wetlands

on the north side of the landfill. These will be collocated with the sediment soil borings. Sediment borings, SD-1 through SD-4, will be augered to 5 feet using a hand auger in wetland areas. Sediment samples will be collected at the surface, 2.5 feet bgs, and 5 feet bgs, yielding 12 samples. The analytical results will provide an indication of whether contaminants present in sediments are leaching to the subsurface from the wetlands surface sediments. Although these wetlands are located topographically upgradient of the landfill, it is suspected that runoff from the landfill cover, which is above grade, flows into these wetlands. Two surface water samples will be collected from the drainage swale originating from the southwest corner of the landfill. SW-5 will be collected close to the landfill and SW-6 will be collected near River Road. These samples will be collocated with surface soil samples described earlier. SW-7 and SW-8 will be collected from ponded water, if present, or any standing water in the vicinity of the former trenches to determine if any contamination is present. SW-9 through SW-11 will be collected in the southwest drainage near the outfall at the Chena River, downgradient of the outfall along the same bank of the river, and upgradient of the outfall on the same bank of the river. SW-12 through SW-14 will be collected from the drainage southeast of the landfill near the outfall, upgradient of the outfall on the same bank, and downgradient of the outfall. Sediment samples SD-7 through SD-11 will be collocated with these surface water samples.

The background surface water/sediment sample (SW-15 and SW-16) locations will be determined at the time of sampling, but will probably be located near the base of Birch Hill, north of the landfill.

Subsamples for the sediment toxicity tests will be taken simultaneously from the same samples to be analyzed for contaminants. A sediment sample will be collected from a clean background reference location, in addition to samples collected from potentially contaminated areas identified as sample locations. The background reference sediment will be selected from the same type of aquatic system, located close to and having the same physical, chemical, and biological characteristics as the sample locations sediments.

A maximum of 16 surface water samples and 24 sediment samples will be collected.

2.1.3.2 Analytical Parameters

All surface water and sediment samples will be analyzed for VOCs, semivolatiles, total dissolved solids, pesticides, alkalinity, and anions/cations. Surface water samples will be analyzed for total and dissolved priority pollutant metals and barium. Sediment samples will be

analyzed for TAL metals. Analytical parameters, sample containers, preservation, and QA/QC for surface water and sediment samples are summarized in Tables 2-3 and 2-4.

2.1.4 Groundwater

Groundwater at the landfill is known to contain levels of VOCs and metals which exceed EPA MCLs (see Section 2 of the Management Plan). Elevated levels of VOCs were detected in wells located in the permafrost-free drainage swale southwest of the landfill and during one sampling event in wells on the east side of the landfill. Trichloroethene, 1,2-dichloroethene (total), and benzene were detected at or above EPA primary MCLs. These and other VOCs detected in groundwater fall into the categories of light non-aqueous phase liquids (LNAPL)s and DNAPLs. LNAPLs will be expected to be found at the vadose zone/water table interface and DNAPLs will be expected at impermeable layers and the bottom of the aquifer. Concentrations of metals are for the most part below EPA primary MCLs, but every sample contained iron and manganese in excess of EPA secondary MCLs. The background level of these metals in groundwater of the area has not been clearly established. During the 1990 sampling event, arsenic exceeded the EPA primary MCL at one well; cadmium and lead exceeded their respective MCLs at other wells (E & E 1991). The origin of this contamination may be the dissolution of naturally occurring minerals. This may also be true for other metals such as lead, manganese, and chromium.

The hydrogeology of the landfill was not clearly defined by previous investigations. A thaw bulb may underlay the landfill. This thaw bulb may or may not be hydraulically continuous with the alluvial aquifer. It is uncertain whether the known permafrost-free areas are in hydraulic continuity with this aquifer or whether they are underlain by permafrost. The proposed sampling program is focused on addressing some of these unknowns.

2.1.4.1 Sampling Location and Rationale

Groundwater is known to be contaminated. The objective of this sampling effort is to define upgradient groundwater conditions, further delineate the extent of contamination, define the routes of leachate migration from the sources, and further define the hydrogeology of the source area.

A total of 11 wells will be installed. Wells will be installed upgradient of the landfill, in the permafrost-free areas south and east of the landfill, and through the permafrost south of the landfill and south of the former trenches (Figure 2-3).

Currently, there is one background well, FW-1, at the Birch Hill Ski Lodge. This well is screened in the bedrock aquifer and, therefore, does not provide comparable analytical results to the wells at the landfill which are screened in the alluvial aquifer. Three background wells will be installed. These wells are expected to be screened below permafrost since there are no known permafrost-free areas upgradient of the source area. MW-1 will be located immediately north of the landfill and screened in the subpermafrost alluvial aquifer to provide background groundwater data. MW-2 will be installed between AP-5593 and AP-5594, and the wells at the Birch Hill Ski Lodge and will be screened in the subpermafrost alluvial aquifer. Analytical data from this well, in addition to providing background information, will aid in determining whether there is a source other than the landfill for the toluene, trichloroethene, and 1,1,2,2-tetrachloroethane found in wells AP-5593 and AP-5594. MW-3, the third background well, will be located south of River Road, north of the southeast drainage, and east of the former trenches. It will be screened in the subpermafrost aquifer. Analytical data from this well will provide groundwater quality data of the deep aquifer upgradient of the former trenches. Information derived from the installation of this well will further define the extent and depth of permafrost in the source area.

MW-4 and MW-5 will be installed in the permafrost-free area on the east side of the landfill between the landfill and wells AP-5593 and AP-5594. MW-4 will be screened at the water table and MW-5 will be screened at approximately 200 feet. Analytical results from this well will aid in determining the source of the contamination found in wells AP-5593 and AP-5594 during the 1990 sampling event. Analytical results from this deep well will still provide an indication of the extent of potential DNAPL contamination. Water level measurements from this well, in conjunction with the wells in the area, will define the direction of groundwater flow in the area.

To determine whether leachate is entering the deep aquifer underlying the source area, deep companion wells (MW-6 and MW-7) will be installed adjacent to existing shallow wells (AP-5595 and FWLF-3) below the permafrost. The shallow wells will be screened at the water table, taliks, or the active layer above the permafrost. The deep wells will be screened in the alluvial aquifer below the permafrost. Analytical results from samples from the deep wells will indicate whether contaminants are leaching into the aquifer from the bottom of the landfill or the trenches; results from the shallow wells will be used as indicators of the condition above the permafrost.

Elevated levels of VOCs detected at wells AP-5588 and AP-5589, located in a permafrost-free drainage swale southwest of the landfill, suggest that some contaminants may be leaching into groundwater from the landfill. Greater horizontal movement of groundwater is likely to occur

along this drainage swale than in permafrost-rich area; therefore, this drainage may be a hydraulic conduit away from the landfill. To aid in the delineation of the potential contaminant plume MW-8, MW-9, and MW-10 will be installed in this drainage swale. MW-8 and MW-10 will be screened at the water table. MW-9 will act as a companion deep well to MW-8 and will be screened at approximately 200 feet. Although, the aquifer may not be at 200 feet bgs, a target drilling depth of 200 feet bgs has been determined to be the maximum investigation depth. Regardless, analytical results from this deep well will provide an indication of the extent of potential DNAPL contamination.

MW-11 will be drilled in the drainage southeast of the landfill, if the drainage proves to be permafrost-free during the geophysical survey. If the drainage is permafrost-free, it may act as conduit for contaminant migration from both the landfill and the trenches south of River Road. If drainage contains permafrost, this well will be relocated to a location to be determined in the field.

During the drilling operations and following completion of monitoring wells, any free-product existing on the water table will be evaluated. Thickness of free-product will be measured (see Section 4) and an assessment of IRA will be considered (see Management Plan).

A comprehensive list of monitoring wells to be completed for the landfill is presented in Table 2-5. In addition to the new wells, the 13 existing wells surrounding the landfill will be sampled and analyzed for the same parameters. Information about these wells is summarized in Table 2-6. Well FW-1, located at the Birch Hill Ski Lodge, will not be sampled during this sampling effort because it is screened in the bedrock aquifer; all the other wells are screened in the alluvial aquifer; therefore, it would not provide representative background data.

2.1.4.2 Analytical Requirements

All groundwater samples will be analyzed for the following: petroleum hydrocarbon classification, semivolatiles, VOCs, priority pollutant metals and barium, chlorinated herbicides, and pesticides/PCBs. In addition, groundwater will be analyzed for tetrahydrofuran (THF), and explosive residues as a precautionary measure since these types of compounds may have been disposed at the landfill. Select groundwater samples will be analyzed for the biological and chemical parameters needed for the engineering studies. Analytical parameters, sample containers, preservatives, and QA/QC for groundwater samples are summarized in Table 2-7.

2.1.5 Ash

Approximately 18 inches of coal ash from the Fort's power plant covers the landfill. Composite samples collected during the 1990 E & E field investigation from the landfill contained high levels of barium (see Section 2 of the Management Plan). The concentration of barium in the ash from that sampling event exceeded a risk-based concentration for ambient air. Other metals were present at levels higher than they normally occur in western United States soils. During the proposed sampling event, discrete ash samples will be collected to further characterize the potential contaminants in the ash. Ash samples will be analyzed to determine if any contaminants could leach into the groundwater and whether the barium problem identified in the previous investigation persists.

2.1.5.1 Sampling Locations/Rationales

Eight discrete ash samples (ASH-1 through ASH-8) will be collected at random locations on the landfill. Potential locations are identified on Figure 2-2. Sample locations selected will be representative of the site.

2.1.5.2 Analytical Parameters

All ash samples will be analyzed for TAL metals, dioxin, pesticides/PCBs, chlorinated herbicides, and semivolatile organic compounds. One ash sample will be analyzed for grain size. Analytical parameters, sample containers, preservatives, and QA/QC for ash samples are summarized in Table 2-8.

2.1.6 Air

Ash from the coal incinerator is applied daily to the landfill as a cover material. The ash contains various heavy metals and may contain DDT. During cover application and bulldozing associated with landfill activities, a potential exists for ash particles to become suspended in the air as dust emissions. Air samples will be collected from downwind locations to determine whether contaminant migration via air is occurring. Analytical results will be used to assess the potential impact of air-borne contaminants on workers, site visitors, and terrestrial biota.

2.1.6.1 Sampling Locations and Rationale

The factors controlling contaminant migration at the landfill include wind direction, wind velocity, frequency of ash application, and volume of material moved during bulldozing. Prevailing winds in the area are generally from the north most of the year, however, during June and July the prevailing winds are southwesterly. Air sampling at the landfill is expected to take place during the RI activities, most likely in the spring or summer. Wind direction and velocity will be determined through the use of a meteorological (met) station. The met station will be positioned in an upwind location away from the landfill and will be used to gather current meteorological data for a 48-hour period prior to sampling. Based upon the determination of current meteorological conditions, downwind and background air sample locations will be selected. Meteorological conditions will be monitored throughout the sampling event and sample locations will be adjusted accordingly to correct for significant wind shifts.

High volume (hi-vol) particulate matter (PM10) air samplers will be utilized for air collection at the landfill. PM10 hi-vol samplers will be used to determine the respirable fraction (e.g., particulate matter less than or equal to 10 micrometers in diameter) of contaminants emanating from the landfill. This fraction represents the greatest hazard to landfill workers and site visitors. Detected concentrations of contaminants in this fraction will be used in evaluating health risks to receptors. A total of five PM10 hi-vols will be erected for sample collection. One sampler will be positioned in an upwind location to establish background conditions. Four samplers will be positioned in three downwind locations. Two samplers will be collocated for QA purposes. Samples will be collected under worst-case conditions during working hours at the landfill. To establish worst-case conditions, samples will be collected during dry and preferably windy climatic conditions and during hours of heavy landfill activity, such as ash application and/or bulldozing. PM10 samples will be collected over 12-hour intervals.

TSP hi-vol samplers will be used to determine concentrations of contaminated TSP emanating from the landfill. TSP concentrations will be used in determining general site characteristics. A total of four hi-vols will be erected for sample collection. One sampler will be positioned in an upwind location to determine background conditions. Three samplers will be positioned in two locations. Two samplers will be collocated for QA purposes. Again, samples will be collected under worst-case conditions (e.g., dry and windy weather). Samples will be collected over consecutive 12-hour intervals with sample termination and initiation coinciding with diurnal wind shifts, if these wind shifts occur.

Samples from hi-vol PM10 and TSP samplers will be collected on consecutive work days at the landfill to assure sampling during worst-case conditions. Data for three days representing the worse-case conditions will be submitted to the laboratory for analysis. The information collected during the sampling event will be supplemented by using a model to predict barium concentrations in air and possible worker exposures.

2.1.6.2 Analytical Parameters

Air samples will be analyzed for TAL analytes as identified in Table 2-9. Laboratory analysis of filters will be conducted by proton induced x-ray emission, analysis of cellulose filters will be conducted by atomic absorption, spectrometric detection. Sampling for DDT, tentatively identified in one coal ash sample, will be deferred pending analytical results from ash samples collected in conjunction with the RI.

Analytical parameters, sample containers, preservation, and QA/QC for air samples are summarized in Table 2-9.

2.2 POWER PLANT COAL STORAGE YARD

The CSY is located west of Meridian Road, south of the Fort Wainwright power plant, and east of the power plant's cooling pond. These areas are depicted on the sample location map on Figure 2-5. The area of concern is shaded on the figure and is located between the cooling pond and a road. The power plant is a coal-fired cogeneration plant, supplying electricity and steam to Fort Wainwright. At the CSY, coal was stored directly on the ground without a liner. While in the storage yard, waste POLs such as diesel, fuel oil, lubricants, and antifreeze compounds were routinely spread over the coal pile to increase the British thermal unit (BTU) content of the coal. This practice has since been revised (Levine 1992; Short 1993). The underlying soils at the CSY may have been contaminated with the various applications of waste POLs. As each pile of coal was utilized in the power plant, the underlying soils and/or coal (approximately 12 inches) were graded, collected, and subsequently burned in the power plant. A new layer of soil and/or coal was then added to the surface of the CSY and the process was repeated. It is not known if the remaining surficial soils contain residual POLs. Previous site visits and investigations have identified an area within the CSY that contained a staging or storage area for drums. Surface spills of materials were routine. Leakage or spillage of material in the drums may also be a source of contaminants. It was also reported that two 10,000-gallon underground storage tanks

(USTs) currently used to store used POLs are located within the drum storage location, and may be a source of subsurface and groundwater contamination.

In 1986, ADCOE installed nine monitoring wells (AP-5505, AP-5506, AP-5507, AP-5508, AP-5509, AP-5510, AP-5511, AP-5512, and AP-5513) in the vicinity of the CSY. Oil and grease concentrations determined using EPA method 9071 in soils ranged from 262 mg/kg to 1,676 mg/kg. In general, the highest concentrations were detected in near-surface soils. It must be noted that the oil and grease analytical method is not comparable to EPA Method 418.1 or ADCOE Modified EPA Method 8015. Pesticides were detected in several near-surface soil samples (boring AP-5507 - 0.0077 mg/kg DDT, boring AP-5510 - 0.051 mg/kg DDT and 0.007 mg/kg DDE, boring AP-5506 - 0.0061 mg/kg DDT). (Well AP-5507 was located in the general vicinity of wells AP-5506 and AP-5505.) Benzene and trichloroethene were the only VOCs detected in soil samples. The concentration of benzene in a soil sample collected between 4 to 5.5 feet bgs in boring AP-5509 was 0.072 mg/kg and between 0 to 1.5 feet bgs in boring AP-5507 was 0.058 mg/kg. Trichloroethene was detected at a concentration of 0.026 mg/kg in a duplicate soil sample collected at 4.5 to 6 feet bgs in boring AP-5505. BNA analysis was only conducted on one soil sample; none were detected (ADCOE 1993). The concentrations of antimony, nickel, mercury, and thallium were, in general, higher at all depths than the normal range for those metals (antimony: 0.22 - 1.01 mg/kg, nickel: 7 - 32 mg/kg, mercury: 0.02 - 0.11, and thallium: 0.1 - 0.8 mg/kg) in soils in the western U.S. In one sample from AP-5509 collected between 4 and 5.5 bgs, the concentration of arsenic (13.5 mg/kg) and selenium (4.9 mg/kg) exceeded the normal range of concentrations of those metals (arsenic: 2.8 - 10.9 mg/kg and selenium: 0.09 - 0.56) (ADCOE 1993) in soils in the western U.S. but not were above levels for Fort Wainwright (Shacklette and Boerngen 1984).

Groundwater samples were collected only from wells AP-5506, AP-5508, AP-5510, and AP-5512. BNA analysis was only conducted on the groundwater sample collected from well AP-5506; phenol was detected at a concentration of 0.003 mg/L. No MCL for phenol is available. The concentration of cadmium detected in groundwater samples from wells AP-5508 and AP-5512 was at the MCL of 0.005 mg/L. Concentrations of antimony, nickel, and thallium exceeded the proposed MCLs (0.01 mg/L, 0.1 mg/L, and 0.002 mg/L, respectively) for those metals (ADCOE 1993).

ADCOE sampled groundwater in June 1991 from seven monitoring wells (AP-5505, AP-5506, AP-5508, AP-5509, AP-5510, AP-5511, and AP-5512) completed around the CSY in

October 1986 and analyzed the groundwater for petroleum hydrocarbons, metals, total organic halides (TOX), and pesticide/PCBs and aromatic volatile compounds. The groundwater samples were analyzed for total petroleum hydrocarbons (TPH) by EPA Method 418.1. Concentrations ranged from not detected at 0.2 mg/L to 0.6 mg/L. No petroleum hydrocarbons were detected using EPA Modified Method 8100; however, petroleum hydrocarbons were detected at a concentration of 0.103 mg/L in one sample of three replicate samples using EPA Modified Method 8015. RCRA metals were identified but concentrations did not exceed MCLs. Groundwater samples analyzed for TOX had concentrations ranging from undetected at 10 mg/L to 38 mg/L. Groundwater samples analyzed for pesticides and PCBs had concentrations of 4-4'-DDD at 0.000718 mg/L in AP-5512, endrin at 0.000687 mg/L in AP-5512, and endrin aldehyde at 0.000768 mg/L and 0.000437 mg/L in wells AP-5505 and AP-5510, respectively (ADCOE 1991a). The concentration of endrin exceeded its MCL of 0.0002 mg/L; there are no MCLs available for the other compounds. No aromatic volatile compounds were detected in any of the groundwater samples, using EPA Method 8020.

Surface soil staining was noted during the June 1991 groundwater sampling event within the CSY which registered readings of organic vapors from 0 to 150 ppm (ADCOE 1991a). The stained soil was subsequently burned in the power plant (TeVrucht 1993). A 500-gallon diesel/mogas spill was also reported in the northern portion of the CSY in 1991 (ADEC 1991).

AEHA investigated surface soil contamination at the CSY from July to August 1991 as a result of a Notice of Violation from ADEC. AEHA sampled soil within the working area of the coal pile, along the road adjacent to the cooling pond and other locations not included in the source area. Coal samples were also collected, collocated with a portion of the surface soil samples collected in the working area of the coal pile. Water samples were collected from the intake and outlet of the cooling pond (AEHA 1991).

Surface soils within the center of the working area of the coal pile contained the highest concentrations of semivolatile organic compounds (semi-VOCs) and VOCs and TPH. Surface soils within the working area of the coal pile contained 2-methylnaphthalene ranging in concentration from 4.3 mg/kg to 16 mg/kg and naphthalene ranging in concentration from 4.5 mg/kg to 12 mg/kg. Concentrations of VOCs ranged from 0.024 mg/kg to 120 mg/kg. The most contaminated samples were located in the central portion of the working area of the coal pile. Table 2-2 summarizes the VOCs and the range of concentrations detected in soils samples from the working area of the coal pile. Soils collected along the road adjacent to the cooling pond contained 1,1,1-

trichloroethane in concentrations ranging from 0.012 to 0.048 mg/kg. Petroleum hydrocarbons ranged in concentrations from the detection limit of less than 0.010 mg/kg to 38 mg/kg. The highest concentrations were detected in the center of the working area of the coal pile and on the road adjacent to the cooling pond. Barium concentrations ranged in soil samples from the CSY from 42 mg/kg to 1,800 mg/kg. Chromium concentrations ranged from 13 mg/kg to 25 mg/kg. Lead concentrations ranged from 22 to 41 mg/kg.

Water samples from the cooling pond were analyzed for petroleum hydrocarbons and metals. Petroleum hydrocarbons were not detected at the detection limit of less than 1 mg/L. Barium and lead were detected in the water samples, but did not exceed MCLs.

Coal was analyzed for metals. The concentrations of arsenic and chromium in the coal were, in general, less than in the associated soil samples. Arsenic concentrations ranged from 1.3 mg/kg to 2.3 mg/kg. Barium concentrations ranged from 320 mg/kg to 430 mg/kg and chromium concentrations ranged from 5.3 mg/kg to 7.2 mg/kg.

In 1991, ADCOE conducted an UST investigation at eight different locations on Fort Wainwright, including an area near and in the CSY. Three wells were installed: one adjacent to the coal pile (well AP-5536) and two upgradient of the CSY (wells AP-5534 and AP-5535), near the contaminated soil piles southeast of the CSY.

Soil samples were analyzed for TRPH, fuel identification, halogenated VOCs, and TCLP lead. The sample collected at 15 feet bgs from boring AP-5736 contained 120 mg/kg TRPH; no fuel was identified in this sample, using ADCOE Modified Method 8015. Two samples from AP-5734 contained detectable levels of TRPH (48 mg/kg in a duplicate sample collected at 5 feet bgs and 45 mg/kg in a sample collected at 10 feet bgs). No other soil samples contained detectable concentrations of TRPH. The soil sample collected at 15 feet bgs from boring AP-5736 contained 12 mg/kg diesel range organics. The sample collected at 10 feet bgs from boring AP-5736 contained toluene at a concentration of 0.028 mg/kg. No other VOCs were detected. Only two samples were analyzed for TCLP lead. The concentrations were below the TCLP lead criterion of 5 mg/L (ADCOE 1992c).

Groundwater samples were analyzed for POLs, BTEX, VOCs, pesticide/PCBs, and RCRA metals. Diesel range organics were detected at a concentration of 44 μ g/L in well AP-5736. No other fuel was detected. The water samples did not contain detectable concentrations of TRPH, pesticides, PCBs, or BNAs. VOCs were detected in groundwater samples, but the same analytes were also detected in the trip or method blanks. Aside from the common laboratory contami-

nants, VOCs detected included 1,1-dichloroethene at concentrations ranging from 0.0076 to 0.014 mg/L (wells AP-5734, AP-5735, and AP-5736) (MCL - 0.007 mg/L); 1,1,1-trichloroethane at concentrations ranging from 0.0004 to 0.0023 mg/L (wells AP-5734 and AP-5735) (MCL - 0.2 mg/L); and xylene at a concentration of 0.0002 mg/L (AP-5735) (MCL - 10 mg/L). No 1,1-dichloroethene or 1,1,1-trichloroethane were detected at detection limits of 0.001 mg/L in duplicate samples. Xylenes were only detected in one of three replicate samples. These compounds were all detected in the trip blank. No metals were detected above MCLs (ADCOE 1991c).

Bituminous coal was found from the surface to 3 feet bgs in boring AP-5735 and from the surface to 4.5 feet bgs in boring AP-5736. No coal was found in the AP-5734 boring. Permafrost was not encountered in any of these borings. Groundwater was encountered between 13.5 and 17 feet bgs. In general, the subsurface lithology of these borings consisted of poorly graded sand with silt to silty with gravel or silt with sand (ADCOE 1991c).

The CSY area is located on the floodplain of the Chena and Tanana Rivers. Surface water runoff is believed to flow through a series of drainageways and ditches and eventually into the Chena River. The CSY is located approximately 1000 feet south-southeast of the Chena River. The surficial soil layer of the floodplain consists of organic silts and fine sands to depths of 7 to 10 feet bgs. Coal ash, coal, and sands have also been identified in ADCOE borings in areas 2.5 to 6 feet bgs (borings AP-5508 and AP-5509). Coal ash identified in the subsurface soils of boring logs provided by ADCOE (1986) may be the source of metals contamination at the CSY. Unconsolidated commonly saturated sand and gravel fluvial deposits underlie the surficial layer. Discontinuous permafrost has been identified in an area north of the CSY at depths of 14 to 82 feet bgs (Pewe and Bell 1975). However, permafrost was not identified in ADCOE borings completed at the CSY in 1986 to depths of 25 feet bgs. Groundwater in wells completed in the CSY area was encountered at 4 to 12 feet bgs. An unconfined aquifer unit underlies the site, although discontinuous permafrost may provide for confining aquifer conditions. Based on the fort-wide groundwater monitoring, groundwater in the CSY flows to the west-northwest toward the Chena River and is consistent with the groundwater flow direction south of the Chena River at Fort Wainwright (ADCOE 1992).

2.2.1 Surface Soils

Surface soils have been determined to be contaminated in previous sampling events; however, soil is periodically graded within the CSY and incinerated with the coal. Therefore, the surface soil currently within the CSY may or may not be contaminated. Surface soils may be contaminated by petroleum, solvents, and/or other combustible products from current practices with the coal pile, leaks or spills in the drum storage location, and leaks from the piping associated with the USTs. Sampling will be conducted at these locations to determine if contamination exists. This information will aid in determining the potential health risks to on-site workers and local residents due to inhalation of, ingestion of, or dermal contact with contaminated soils.

2.2.1.1 Sampling Locations and Rationale

The factors influencing contaminant migration in surface soils at the CSY include the physical characteristics of the soil and the behavior of contaminant migration in the soil. Surficial soils in CSY area consist of organic silts and fine sands which are assumed to have low permeability. Organic contaminants are expected to sorb to carbon (naturally occurring and coal particles) and silt/clay surfaces and not migrate far from the origin of spills or leaks. However, if spills have been of large enough volumes, contamination might be expected to have greater areal extent.

Surface soil samples will be collected at the surface of monitoring well/soil boring locations. Samples will be collected from the indigenous soil material after coal is cleared from an area. Surface soil samples collected from MW-1 will be used to establish upgradient/background conditions for the CSY. Analytical results from surface soil samples collected from SB-1, SB-2, and MW-4 will determine if surficial soils are contaminated in the drum storage area and around the fill pipes of the USTs. Surface soil samples from SB-3 and SB-4 will be used to characterize surface contaminants, determine extent of any contamination, and confirm whether any surficial contamination is remaining following grading of the surface soils during historic use of the coal yard. No surface soil samples will be collected from MW-2 and MW-3 since sediment samples will be collected in the immediate vicinity.

Six surface soil samples are expected to be collected from the CSY. Additional surface soil samples will be collected and screened if there is visual evidence of potential contamination (e.g.,

discolored soils, stressed vegetation, or field analytical results warrant sample collection at additional locations).

2.2.1.2 Analytical Parameters

Petroleum, solvents, and other combustible products are the primary contaminants at the CSY. Analytical parameters, sample containers, preservations, and QA/QC for surface soil samples are summarized in Table 2-10.

2.2.2 Subsurface Soils

Subsurface soils are presumed to be potentially contaminated by petroleum, solvents, and/or other combustible products from historical application of waste products to coal, leaks and/or spills from the drum storage location, and leaks from the USTs located in the northeast corner of the site. During previous investigations in the CSY, benzene, trichloroethene, TRPH, diesel range organics, and toluene have been detected in subsurface soils. Borings within the CSY have contained coal ash from the power plant which could be a source of metals contamination. Sampling at these locations will define the nature and extent of contamination in the subsurface. Remedial action alternatives will be evaluated based on the contaminant concentration data generated.

2.2.2.1 Sampling Locations and Rationale

Contaminant migration in subsurface soils at the CSY is influenced by the physical characteristics of the underlying soils (silt, sand, gravel) and the physical and chemical behavior of contaminant migration in the subsurface, whether transported by groundwater flow, groundwater fluctuations, free product movement, or gravity induced movement in the vadose zone. In general, organic contaminants are expected to sorb to subsurface carbon (naturally occurring or coal particles) and/or silt/clay surfaces typical of surficial soils in the CSY and not migrate far from their origin. Contaminants can easily migrate through the highly transmissive underlying sands and gravels that exist in the CSY area. The types of contaminants reported to have been detected in wells at the CSY suggest that contaminants may have migrated through surficial deposits and underlying sand and gravel to the groundwater table. Groundwater flow and fluctuations will continue to promote the migration of contamination throughout the subsurface soils.

Subsurface soil samples will be collected at the monitoring well/soil boring locations according to methodology and field screening results, discussed in Section 5.2. At least two subsurface soil samples will be collected from each borehole for project laboratory analysis. Subsurface soil samples from MW-1 will provide upgradient/background conditions for the CSY. Subsurface soil samples from SB-1, SB-2, and MW-4 will be used to characterize the subsurface of the drum storage area and the area near the USTs. Subsurface samples from SB-3 and SB-4 will be used to establish the presence or absence of contamination below the active coal pile. Subsurface soil samples from MW-2 and MW-3 will be used to determine if contaminants have migrated downgradient from the CSY toward the Fort Wainwright water supply wells and the Chena River.

It is expected that a total of 8 soil borings will be completed at the CSY to collect subsurface soil samples, 1 of which will be at a background location (MW-1), and 4 of which will be utilized for monitoring wells/piezometers (MW-1, MW-2, MW-3, and MW-4).

2.2.2.2 Analytical Parameters

Petroleum, solvents, and other combustible products are the primary contaminants of concern at the CSY. Analytical parameters, sample containers, preservations, and QA/QC for subsurface soil samples are summarized in Table 2-11.

2.2.3 Surface Water and Sediment

Surface water and sediment, if present along drainages, may be contaminated by petroleum, solvents, and/or other combustible products from practices conducted at the CSY. Sampling at these locations will define the natural potential surface migration pathways toward the Chena River and other observed drainage pathways. The cooling pond may collect groundwater discharge, through which contaminants may have migrated to the cooling pond sediments. The drainages have not been sampled previously. Water samples from the cooling pond contained low levels of petroleum hydrocarbons. The drainages have not been sampled previously.

2.2.3.1 Sampling Locations and Rationale

Important influences in the migration of contaminants in and to surface water and sediments at the CSY are the drainage pathways, surface water transport of contaminants, and the behavior of the migration of contaminants in surface water. Contaminants in surface water may migrate

downslope during periods of precipitation either suspended on the top of the water, as a sheen, or dissolved in the water. Denser contaminants may displace the water and move toward the bottom of the drainage pathway or pond, or be transported along with groundwater flow. Contaminants being transported in surface waters will become diluted in the larger volume of water of the Chena River, in which many of the drainage pathways empty. Sediment contamination will likely occur in areas where surface water contamination exists and the contaminants have come into contact with the sediments. Sediments will likely be transported downstream during surface water flow. During the high flow seasons of spring and late summer, large volumes of water and sediments may be transported.

Surface water and sediments samples along drainages will be collected in four locations: SD-1, SD-2, SD-3, and SD-4. The surface water and sediment locations are conditional and are likely to be altered in the field to areas observed as possibly being affected by surface waters. Surface water and sediment samples from SD-1, SD-2, SD-3, and SD-4 locations will be established along major drainage pathways identified at the CSY. In the event that no surface water is available, sediment samples will still be collected from the identified locations.

Sediments in the cooling pond may have been impacted by contaminants migrating downgradient via groundwater as the groundwater discharged in the pond area. Inorganics or organics that have partitioned to surrounding soils will be less likely to migrate from source areas (e.g., coal pile). They may, however, be in a mobile state where migration can occur similarly to petroleum contaminants. Petroleum contaminants that have migrated through the soil column and to the groundwater table may migrate with the groundwater. Since the groundwater discharges at the cooling pond, sediments may become contaminated. VOCs or light petroleum compounds may release into the water and become dissolved or volatilized during recirculation by the power plant. Previous sample results of cooling pond water indicate that the water has not been contaminated.

Five sediment samples (SD-5 through SD-9) will be collected within the pond area. Sediment samples will be collected near the inlet and outlet of the recirculation pipes and the remaining three samples will be collected at random locations. Two surface water samples will be collected to confirm that the cooling pond water remains uncontaminated. These will be collocated with sediment samples SD-7 and SD-9. A background surface water/sediment sample (SD-10) will be collected in an appropriate background location. A total of 10 sediment samples and 7 surface water samples will be collected from the CSY.

2.2.3.2 Analytical Parameters

The primary contaminants of concern at the CSY are petroleum, solvents and other combustible products. Analytical parameters, sample containers, preservations, and QA/QC for surface water and sediment samples are summarized in Table 2-12 and Table 2-13, respectively.

2.2.4 Groundwater

Probable groundwater contaminants include petroleum, solvents and/or other combustible products from historical application of waste products to coal, leaks or spills from the drum storage location, and leaks from the USTs located northeast of the site. Existing monitoring wells completed at the CSY have been sampled for groundwater and indicate that contamination exists. Sampling at existing well locations and new well locations is necessary to define the nature and extent of contamination at the CSY. Also, due to the proximity of Fort Wainwright municipal water supply wells, five water supply wells are scheduled to be sampled.

2.2.4.1 Sampling Locations and Rationale

The factors at the CSY that affect contaminant migration in groundwater include the physical characteristics of the subsurface soils (hydraulic conductivity, transmissivity), the behavior of contaminants in groundwater, and transient conditions of groundwater flow direction and gradient change, particularly the stage influences of the nearby Chena River on the groundwater at the CSY. Contaminated subsurface soils are expected to contribute a dissolved fraction of contamination to the groundwater. Groundwater flow will influence the direction of dissolved contaminant movement. Because of the transmissive nature of the subsurface soils and the transient conditions of the groundwater and Chena River stage, an exact distribution of contaminated groundwater is impossible to predict with the available data. All monitoring wells completed at the CSY will be used to establish groundwater flow directions and gradients. A piezometer nest will also be installed to provide data on the vertical components of groundwater flow adjacent to the cooling pond, as well as local flow direction information.

Table 2-14 summarizes the monitoring wells proposed for installation at the CSY, their basic construction and type, as well as a brief description for their location. Table 2-15 summarizes the basic construction and type of existing wells to be sampled at the CSY. Rationale for monitoring well locations is discussed in the following text.

Groundwater samples will be collected from 13 existing monitoring wells/piezometers in the CSY area (AP-5734, AP-5735, AP-5736, AP-5505, AP-5506, AP-5508, AP-5509, AP-5510, AP-5511, AP-5512, AP-5517, AP-4856, and AP-4912); 6 water supply wells (Well 119, 99, 124, AP-3595, 3559A, 3559B) in the CSY area; and 4 proposed monitoring wells/piezometers (MW-1, MW-2, MW-3, and MW-4).

Groundwater samples from proposed monitoring well MW-1 and existing AP-5734 will provide upgradient/background conditions for the CSY. Groundwater samples from MW-2 and MW-3 will be used to determine if contaminants have migrated via groundwater downgradient from the CSY toward the Fort Wainwright water supply wells (Well 119, 3599A, 3559B) and the Chena River. MW-2 and MW-3 will be installed as piezometers. Groundwater samples from MW-4 will be used to characterize groundwater near the two 10,000-gallon used oil USTs and the drum storage area in the event that leaks or spills have contaminated groundwater.

While the main purpose for installing these wells and piezometers is to establish groundwater flow directions and gradients, they may provide information on the extent of contamination and on background or upgradient conditions. The deep piezometer (MW-3) to be completed at the piezometer nest location may be used to determine if dissolved contaminants are affecting the aquifer at depth and provide vertical gradient data. It is expected that 4 monitoring wells, which includes one piezometer nest consisting of two piezometers will be completed at the CSY.

2.2.4.2 Analytical Parameters

Petroleum, solvents, and other combustible products are the primary contaminants of concern at the CSY. Analytical parameters, sample containers, preservations, and QA/QC for groundwater samples are summarized in Table 2-16.

2.3 FIRE TRAINING PITS

The FTPs for Fort Wainwright are located in the main cantonment area, approximately 300 feet south of Montgomery Road near the southeast corner of the runway. The FTPs consist of pits 3A and 3B depicted on the sample location map on Figure 2-6. FTP 3A is located west of FTP 3B. A gate at the northeastern corner of the FTP area restricts vehicular traffic. FTP 3A consists of a large square grassy area surrounded by trees. A 50-foot diameter circular area of black-stained soils, with a strong petroleum odor, is located in the southern portion of FTP 3A. A row of charred junk cars and trucks which had been burned in the pit line the western edge of

FTP 3A (E & E 1992). FTP 3B consists of a 7.5 acre area that is 1 to 3 feet lower than the surrounding forest. In the center of FTP 3B is a 5- to 10-foot diameter area that is filled with gravel and small pieces of concrete. The depression in FTP 3B has become vegetated with grass and saplings (E & E 1992).

The FTPs were used for the training of fire department and rescue crews. Containerized flammable liquids were stored at the FTP sites and later burned during fire extinguishing training exercises in unlined pits. Fuels known to be burned included diesel, JP-4, and waste oil. Solvents may have been added to the waste oil. An estimated 1,500 to 2,300 gallons of flammable liquids were burned per year in the FTPs (ADCOE 1989). For the most part, aside from pit interior excavations, the surfaces of the FTPs are level with the surrounding ground surface, and pit perimeters do not include surface water runoff diversion systems (E & E 1991).

The FTPs have been investigated since 1986. Subsurface soil samples collected from three soil borings in FTP 3A were analyzed for VOCs in the first investigation. Only bis(2-ethylhexyl) phthalate (17 ppm), a common laboratory contaminant, was present in the soils above detection limits.

In a 1989 soil gas survey, soil gas probes were driven to a maximum depth of 20 feet into FTP 3A. Benzene, toluene, and xylenes were detected at maximum concentrations of 1,600 parts per million volatiles (ppmv), 5,400 ppmv, and 310 ppmv, respectively, in probes located within the pit (WCC 1990). In addition, unidentified hydrocarbons were detected. A groundwater sample collected through a probe driven into the groundwater contained acetone (3.7 ppm) and dichlorofluoromethane (0.026 ppm). Results of another 1989 investigation revealed that FTP 3B contained FTP-related contaminants including diesel range hydrocarbons, phenanthrene, and xylenes.

Another investigation was conducted in 1991. FTP 3A surface soil contained diesel range hydrocarbons at concentrations (21,460 mg/kg) that exceed the ADEC regulatory matrix concentrations. FTP 3B also contained diesel range hydrocarbons from 2.5 feet bgs to 8.5 feet bgs at concentrations (1,370 to 1,707 mg/kg) that exceed the ADEC regulatory matrix concentration. FTPs 3A and 3B also contained compounds above background concentrations, but not above federal or state regulatory limits. Contaminants detected in the surface soil of FTP 3A included benzene (421 µg/kg), toluene (1,611 µg/kg), xylenes (2,205 µg/kg), lead (99.3 mg/kg), and zinc (216 mg/kg). Analysis of subsurface soil from FTP 3A did not reveal any contamina-

tion. Subsurface samples from FTP 3B contained xylenes (1,167 $\mu\text{g/kg}$), and 2-methylnaphthalene (1,470 $\mu\text{g/kg}$) from 2.5 feet bgs to 4.0 feet bgs.

2.3.1 Surface Soils

Surface soils at FTP 3A are known to contain diesel range hydrocarbons, BTEX, and metals. Surface soil samples have not been collected at FTP 3B, but are presumed to be contaminated by petroleum, solvents, and/or other combustible products from historical application of the products for fire training activities at the site and the presence of contaminants in subsurface soils. Sampling at the FTPs is designed to define the nature and extent of contamination. This information will aid in determining the potential health risks to nearby on-site workers and local residents due to inhalation of, ingestion of, or dermal contact with contaminated soils. Remedial action alternatives will be evaluated based on the contaminant concentration and volume data generated. Surface soil sample locations are presented in Figure 2-6.

2.3.1.1 Sampling Locations and Rationale

The factors influencing contaminant migration in surface soils at the FTPs include the physical characteristics of the soil and the behavior of contaminant migration in the soil. Organic contaminants are expected to sorb to organic carbon and silt/clay surfaces and not migrate far from the origin of the spill or leak. However, if large volumes of contaminant have spilled, contamination might be expected to have greater areal extent.

Surface soil samples will be collected at the surface of monitoring well/soil boring locations and at other discrete locations.

FTP 3A has not been completely characterized in previous investigations. Surface soil samples from MW-1 and MW-2 will provide upgradient/background conditions for FTP 3A. Surface soil samples from MW-9 and MW-10 will provide areal extent of contamination for FTP 3A. A surface soil sample grid and soil borings (SB-1 to SB-7) will be established to characterize the large oil stain, the small oil stain, and the former drum storage areas at FTP 3A. Surface soil samples from MW-11, MW-12, and MW-13 will be used to delineate any downgradient contamination from FTP 3A. Sixteen surface soil samples (SS-1 through SS-16) will be collected in a grid pattern at 20-foot intervals from the large 50-foot diameter stained soil area in the southern portion of FTP 3A. The gridded surface soil samples will delineate laterally the extent of surface contamination at the stained area. The sampling grid extends outside the visually stained area to

determine if unstained soil is also contaminated. Thirteen surface soil samples (SS-17 through SS-29) will be collected from a grid at the former drum storage area to delineate the extent of contamination. The grid will have a pattern similar to the one described previously. Five surface soil samples will be collected from the small stained soil area in the northern portion of FTP 3A. The center surface soil sample (SB-1) will characterize the stain, while the four outlier samples (SS-30 through SS-33) will be used to document the lateral extent of contamination. The gridded area may be extended depending on screening analysis results. A surface soil sample (SS-34) will be collected adjacent to the drum in the FTP 3A area to confirm the presence of contamination.

Surface soils at FTP 3B have been sampled previously (E & E 1991); additional surface soil samples from soil boring/monitoring well locations will be used to confirm extent of contamination. Surface soil samples from MW-3 will provide upgradient/background conditions for FTP 3B. Surface soil samples (SS-35 and SS-36) will be collected in FTP 3B to confirm the presence of surface contamination. Surface soil samples from MW-4, MW-5, and MW-6 will be used to confirm the extent of contamination at FTP 3B. Surface soil samples from MW-7 and MW-8 will be used to delineate surface soil contaminants downgradient from FTP 3B.

It is expected that 56 surface soil samples will be collected from the FTPs.

2.3.1.2 Analytical Parameters

Petroleum, solvents, and other combustible products are the primary contaminants of concern at the FTPs. Analytical parameters, sample containers, preservations, and QA/QC for surface soil samples are summarized in Table 2-17.

2.3.2 Subsurface Soils

Previous sampling at FTP 3B had indicated the presence of diesel range hydrocarbons, xylenes, and 2-methyl-naphthalene in subsurface soils. Although contamination was not detected in subsurface soils in the most recent investigation, the 1989 soil gas survey identified the presence of BTEX at depth. Sampling will define the nature and extent of contamination in the subsurface. Remedial action alternatives will be evaluated based on the contaminant concentration data generated. Subsurface soil sampling locations are presented in Figure 2-6.

2.3.2.1 Sampling Locations and Rationale

Contaminant migration in subsurface soils at the FTPs is influenced by the physical characteristics of the underlying soils (silt, sand, gravel) and the behavior of contaminant migration in the subsurface (i.e., whether transported by groundwater flow, groundwater fluctuations, free product movement, or gravity induced movement in the vadose zone). The potential sources at the FTPs are underlain by 5 to 10 feet of silt which is assumed to have low permeability and transmissivity. Organic contaminants are expected to sorb to organic carbon and/or silt/clay surfaces and not migrate far from their origin. If application of contaminants during fire training activities have been in large enough volumes, contaminants may be expected to travel through subsurface soils to the groundwater table. Subsurface soil and vapor contamination has already been identified at the FTPs and groundwater contamination is believed to have occurred. Once in contact with groundwater, groundwater flow and fluctuations will then continue to promote the migration of contamination throughout the subsurface.

Subsurface soil samples will be collected at the monitoring well/soil boring locations (Figure 2-8) according to methodology and field screening results, discussed in Section 5.2. A maximum of two subsurface soil samples per borehole will be collected to send to the project laboratory.

Subsurface soil boring/monitoring wells MW-1 and MW-2 will be drilled southeast of FTP 3A to provide upgradient/background conditions for FTP 3A. One boring, SB-1 will be drilled at the northern stained soil area, two soil borings/monitoring wells (SB-7 and MW-9) will be drilled at the former drum storage area, and five soil borings (SB-2, SB-3, SB-4, SB-5, SB-6) will be drilled in and along the outer edges of the large southern stained soil area. Three subsurface soil borings/monitoring wells (MW-11, MW-12, and MW-13) will be drilled downgradient of FTP 3A to determine if contaminant migration has occurred. Overall, 20 soil borings are proposed to be completed to collect subsurface soil samples.

2.3.2.2 Analytical Parameters

Petroleum, solvents, and other combustible products are the primary contaminants of concern at the FTPs. Analytical parameters, sample containers, preservations, and QA/QC for subsurface soil samples are summarized in Table 2-18.

2.3.3 Surface Water and Sediment

Surface water and sediment, if present in the drainage pathways, wetlands, and pond near the FTPs, may have been contaminated by petroleum, solvents and/or other combustible products from historical application during fire training activities. Previous sampling efforts have not investigated this potential pathway. Sampling will characterize the nature of contamination in the wetlands and drainage pathways. This information will aid in determining the potential health risks to nearby on-site workers and local residents due to inhalation of, ingestion of, or dermal contact with contaminated soils. Remedial action alternatives will be evaluated based on the contaminant concentration data generated. Surface water and sediment sample locations are identified in Figure 2-6.

2.3.3.1 Sampling Locations and Rationale

Important influences in the migration of contaminants in and to surface water and sediments at the FTPs are the drainage pathway flows, surface water transport of contaminants, and the migration behavior of contaminants in surface water. Contaminants in surface water may migrate downslope along the drainage pathways either suspended on the top of the water, as a sheen, or dissolved in the water. Denser contaminants may displace the water and pool near the bottom of the drainage pathways where they would be transported by moving surface waters. Contaminants in surface water at the pond or wetlands will become diluted in the larger volumes of water (pond or the Chena River) in which many of the drainage pathways empty. Sediment contamination will likely occur where contaminants in surface water are in direct contact with sediments such as in low lying areas and drainage ditches where surface water contamination exists or historically existed. Sediments will probably migrate downstream along with the direction of surface water flow. During the high flow seasons of spring and late summer, large volumes of water and sediments may be transported.

Surface water and sediment samples will be collected at the wetlands, at the pond, and in the ditches and drainage pathways in the FTPs area. If surface water is not present at the time of the sampling activities, then only a sediment sample may be collected. Surface water and sediment samples from SD-1, SD-2, and SD-15 will be used to establish upgradient and background conditions in the FTP area. Additional samples (SD-3 through SD-14) from the drainage pathways and wetlands in the area will be used to characterize potential contaminant migration from FTP 3A and FTP 3B. Samples SD-3 through SD-6 will be used to characterize the ditch

located north of the FTPs which is believed to drain to the Chena River. Samples SD-7 through SD-14 will characterize the wetlands between and near FTPs 3A and 3B in the event that contaminants were transported overland by precipitation events or through groundwater discharging to the wetlands. A total of 15 surface water and sediment samples will be collected at the FTPs.

2.3.3.2 Analytical Parameters

The primary contaminants of concern at the FTPs are petroleum, solvents and other combustible products. Analytical parameters, sample containers, preservations, and QA/QC for surface water and sediment samples are summarized in Table 2-19 and Table 2-20.

2.3.4 Groundwater

Groundwater is suspected to be contaminated by petroleum, solvents and/or other combustible products from historical application of the products during fire training activities. One groundwater sample collected during the soil gas survey contained acetone and dichlorofluoromethane. Sampling will define the nature and extent of contamination at the FTPs. Remedial action alternatives will be evaluated based on the contaminant concentration and physical data generated.

2.3.4.1 Sampling Locations and Rationale

The factors at the FTPs that affect contaminant migration in groundwater include the physical characteristics of the subsurface soils (hydraulic conductivity, transmissivity), the behavior of contaminants in groundwater, the transient conditions of groundwater flow direction and gradient change, particularly with the influences of the Chena River (located 0.4 miles to the northwest). Contaminated subsurface soils are expected to contribute a dissolved fraction of contamination to the groundwater. Groundwater flow direction and gradient will influence the direction of dissolved contaminant movement. Because of the hydraulic nature of the subsurface soils, the transient conditions of groundwater flow and gradient, and Chena River stage; an exact distribution of contaminated groundwater is impossible to predict with the available data. All monitoring wells completed at the FTPs will be used to establish groundwater flow directions and gradients. A piezometer nest will be installed to provide data on the vertical components of groundwater flow, as well as local flow direction information.

Table 2-21 summarizes the monitoring wells and piezometers proposed for installation at the FTPs, their basic construction and type, as well as a brief description of their location. Rationale for monitoring well locations is discussed below. Groundwater samples will be collected from existing (AP-5312, AP-5295) (Table 2-22) and proposed monitoring wells (Figure 2-6); additional groundwater samples may also be collected from the piezometers in the piezometer nest to be completed at the FTPs.

Monitoring wells MW-1 and MW-2 will provide upgradient/background conditions for FTP 3A. Monitoring well MW-10 will be installed between the northern and southern areas of stained soil at FTP 3A. Sampling of the well will determine if contaminants that were detected in the surface soil sample in this area have migrated to groundwater. One well (MW-9) will be installed at the former drum storage area to determine if contaminants have migrated to groundwater in this area. If contaminants infiltrated through the soil to groundwater, they would potentially migrate to the northwest, the direction of regional groundwater flow. MW-11, MW-12, and MW-13 will be placed to intercept such a plume if one exists. MW-11, MW-12, and MW-13 will comprise a piezometer nest of one well and two piezometers to provide hydraulic parameters of vertical and horizontal groundwater gradients. These piezometers and the well will be sampled. Two existing piezometers (AP-5295 and AP-5312) will be sampled as well.

At FTP 3B, MW-3 will provide upgradient/background conditions for FTP 3B. Monitoring wells MW-4, MW-5, and MW-6 will provide areal extent of groundwater contamination that may be present at FTP 3B. Monitoring wells MW-7 and MW-8 will provide downgradient conditions for FTP 3B. If groundwater contamination has occurred, migration would be toward the west-northwest in the regional flow direction.

While the main purpose for installing the wells and piezometers is to establish groundwater flow directions and gradients, they may provide information on the extent of contamination and on background or upgradient conditions. The deep piezometer (MW-12) to be completed to 100 feet bgs at the FTPs may be used to determine if dissolved contaminants are affecting the aquifer below any permafrost which may be encountered, at a depth in which many of the domestic and water supply wells in the floodplain are completed. A total of 13 monitoring wells and/or piezometers are proposed to be installed at the FTPs. A total of 15 wells are proposed to be sampled.

2.3.4.2 Analytical Parameters

Petroleum, solvents, and other combustible products are the primary contaminants of concern at the FTPs. Analytical parameters, sample containers, preservations, and QA/QC for groundwater samples are summarized in Table 2-23.

Table 2-1
LANDFILL
SAMPLE COLLECTION SUMMARY
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
SURFACE SOIL

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/Quality Control
44 (2 background)	VOC (SW-846 ^a Method 8260)	Two 2-oz. glass VOA vials with Teflon-lined septa	4°C	4 field duplicates, 4 lab QC samples 1 trip blank/shipment
44 (2 background)	TOC (SW-846 Method 9060)	8-oz. glass jar with Teflon-lined lid	4°C	4 field duplicates, 4 lab QC samples
44 (2 background)	Pesticide/PCBs (SW-846 Method 8080)	8-oz. glass jar with Teflon-lined lid	4°C	4 field duplicates, 4 lab QC samples
44 (2 background)	Chlorinated herbicides (SW-846 Method 8150)	8-oz. glass jar with Teflon-lined lid	4°C	4 field duplicates, 4 lab QC samples
44 (2 background)	Target Analyte List metals (SW-846 6010 and 7000 series methods)	8-oz. glass jar with Teflon-lined lid	4°C	4 field duplicates, 4 lab QC samples
44 (2 background)	Semivolatile organic compounds (SW-846 Method 8270)	8-oz. glass jar with Teflon-lined lid	4°C	4 field duplicates, 4 lab QC samples
4	Atterberg limits (ASTM D4318) ^b , specific gravity (ASTM D854), moisture content (ASTM D2216), grain size ((ASTM D421, D422)	1-quart glass jar with Teflon-lined lid	None	None
4	Nitrate/nitrite (EPA ^c 353.2), phosphorus (EPA 365.2)	8-oz. glass jar with Teflon-lined lid	4°C	None
44 (2 background)	Petroleum hydrocarbon classification EPA Modified Method 8015 ^d	8-oz. glass jar with Teflon-lined lid	4°C	4 field duplicates, 4 lab QC samples
2	Gas-Range Organics (ADEC Modified Method 8015) ^e	Two 2-oz glass jars with Teflon-lined lids	4°C	None
2	Diesel-Range Organics (ADEC Method AK.102) ^f	4-oz glass jar with Teflon-lined lid	4°C	None
44 (2 background)	TRPH (EPA 418.1) ^c	8-oz. glass jar with Teflon-lined lid	4°C	4 field duplicates, 4 lab QC samples
4	TCLP (extraction by SW 846 Method 1311, see individual methods)	8-oz. glass jar with Teflon-lined lid	Archive	1 field duplicate, 1 lab QC sample

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Table 2-1 (Cont.)

PCB - polychlorinated biphenyls	VOC - volatile organic compounds
QC - quality control	VOA - volatile organic analytes
TRPH - total recoverable petroleum hydrocarbons	TCLP - toxicity characteristic leaching procedure
TOC - total organic carbon	

- a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.
- b - Methods are contained in American Standards for Testing Materials (ASTM).
- c - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.
- d - The modification of Method 8015 will be the United States Army Corps of Engineers proposed method.
- e - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska.
- f - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

Table 2-2
LANDFILL
SAMPLE COLLECTION SUMMARY
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
SUBSURFACE SOIL

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
32 (12 background)	VOC (SW-846 ^a Method 8260)	Two 2-oz. glass VOA vials with Teflon-lined septa	4°C	1 trip blank/shipment 1/10 field duplicates, 1/20 lab QC samples, 1 equipment rinsate/ day
32 (12 background)	TOC (SW-846 Method 9060)	8-oz. glass jar with Teflon-lined lid	4°C	1/10 field duplicates, 1/20 lab QC samples, 10 equipment rinsate/ day
32 (12 background)	Pesticide/PCBs (SW-846 Method 8080)	8-oz. glass jar with Teflon-lined lid	4°C	1/10 field duplicates, 1/20 lab QC samples, 1 equipment rinsate/ day
32 (12 background)	Target Analyte List metals, (SW-846 6010 and 7000 series methods)	8-oz. glass jar with Teflon-lined lid	4°C	1/10 field duplicates, 1/20 lab QC samples, 1 equipment rinsate/ day
32 (12 background)	Semivolatile organic compounds (SW-846 Method 8270)	8-oz. glass jar with Teflon-lined lid	4°C	1/10 field duplicates, 1/20 lab QC samples, 1 equipment rinsate/ day
4	Atterberg limits (ASTM D4318) ^b , specific gravity (ASTM D854), moisture content (ASTM D2216), grain size ((ASTM D421, D422)	1-quart glass jar with Teflon-lined lid	None	None
32 (12 background)	Chlorinated herbicides (SW-846 Method 8150)	8-oz. glass jar with Teflon-lined lid	4°C	1/10 field duplicates, 1/20 lab QC samples, 1 equipment rinsate/ day
32 (12 background)	Petroleum hydrocarbon classification (SW-846 Modified Method 8015) ^d	8-oz. glass jar with Teflon-lined lid	4°C	1/10 field duplicates, 1/20 lab QC samples, 1 equipment rinsate/ day
32 (12 background)	TRPH (EPA ^c 418.1)	8-oz. glass jar with Teflon-lined lid	4°C	1/10 field duplicates, 1/20 lab QC samples, 1 equipment rinsate/ day
4	Nitrate/nitrite (EPA 353.2), phosphorus (EPA 365.2)	8-oz. glass jar with Teflon-lined lid	4°C	1/10 field duplicates, 1/20 lab QC samples

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<p align="center">Table 2-2</p> <p align="center">LANDFILL</p> <p align="center">SAMPLE COLLECTION SUMMARY</p> <p align="center">FORT WAINWRIGHT, OPERABLE UNIT 4</p> <p align="center">FAIRBANKS, ALASKA</p> <p align="center">SUBSURFACE SOIL</p>				
Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
2	Gas-Range Organics (ADEC Modified Method 8015) ^e	Two 2-oz glass jars with Teflon-lined lids	4°C	None
2	Diesel-Range Organics (ADEC Method AK.102) ^f	4-oz glass jar with Teflon-lined lid	4°C	None
4	TCLP (extraction by SW-846 Method 1311, see individual methods)	8-oz. glass jar with Teflon-lined lid	Archive	1 field duplicate, 1 lab QC sample

PCB - polychlorinated biphenyls
 QC - quality control
 TCLP - toxicity characteristic leaching procedure
 TOC - total organic carbon
 TRPH - total recoverable petroleum hydrocarbons
 VOA - volatile organic analytes
 VOC - volatile organic compounds

- a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.
- b - Methods are contained in American Standards for Testing Materials (ASTM).
- c - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.
- d - The modification of Method 8015 will be the United States Army Corps of Engineers proposed method.
- e - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska.
- f - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

<p align="center">Table 2-3</p> <p align="center">LANDFILL</p> <p align="center">SAMPLE COLLECTION SUMMARY</p> <p align="center">FORT WAINWRIGHT, OPERABLE UNIT 4</p> <p align="center">FAIRBANKS, ALASKA</p> <p align="center">SURFACE WATER</p>				
Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
16 (2 background)	VOC (SW-846 ^a Method 8260)	Two 40-mL glass VOA vials with Teflon-lined septa	2 drops concentrated HCl; 4°C	1 field blank/day 2 field duplicates, 1 lab QC sample 1 trip blank/shipment
16 (2 background)	Semivolatile organic compounds (SW-846 Method 8270)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicates, 1 lab QC sample
16 (2 background)	Pesticide/PCBs (EPA ^b Method 608)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicates, 1 lab QC sample
16 (2 background)	Chlorinated herbicides (SW-846 Method 8150)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicates, 1 lab QC sample
16 (2 background)	Petroleum hydrocarbon classification (SW- 846 Modified Method 8015) ^d	1-liter amber glass bottle with Teflon- lined lid	4°C	2 field duplicates, 1 lab QC sample
1	Gas-Range Organics (ADEC Modified Method 8015) ^e	Three 40-mL glass VOA vials with Teflon-lined septa	HCl to pH <2; 4°C	None
1	Diesel-Range Organics (ADEC Method AK.102) ^f	1-liter amber glass bottle with Teflon- lined lid	HCl to pH <2; 4°C	None
16 (2 background)	TRPH (EPA ^b 418.1)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C HCl to pH <2	2 field duplicates, 1 lab QC sample
16 (2 background)	Priority pollutant metals and barium (EPA 200 series)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2	2 field duplicates, 1 lab QC sample
16 (2 background)	Dissolved priority pollutant metals and barium (EPA 200 series)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2 (filtered)	2 field duplicates, 1 lab QC sample
16 (2 background)	Total dissolved solids (EPA 160.1), alkalinity (EPA 310.1)	1-liter polyethylene bottle with polyethylene-lined lid	4°C	1 lab QC sample 2 field duplicates

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<p align="center">Table 2-3</p> <p align="center">LANDFILL</p> <p align="center">SAMPLE COLLECTION SUMMARY</p> <p align="center">FORT WAINWRIGHT, OPERABLE UNIT 4</p> <p align="center">FAIRBANKS, ALASKA</p> <p align="center">SURFACE WATER</p>				
Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
16 (2 background)	Major cations (I-1472-85°)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2; 4°C (filtered)	1 lab QC sample 2 field duplicates
16 (2 background)	Major anions (I-2058-85°)	1-liter polyethylene bottle with polyethylene-lined lid	4°C (filtered)	1 lab QC sample 2 field duplicates
16 (2 background)	Nitrate/nitrite (EPA 353.2)	1-liter polyethylene bottle with polyethylene-lined lid	H ₂ SO ₄ to pH < 2; 4°C	1 lab QC sample 2 field duplicates

PCB - polychlorinated biphenyls

QC - quality control

TRPH - total recoverable petroleum hydrocarbons

VOC - volatile organic compounds

VOA - volatile organic analytes

- a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.
- b - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.
- c - Methods are contained in USGS Methods for Determination of Inorganic Substances in Water and Fluvial Sediments, 1989.
- d - The modification of Method 8015 will be the United States Army Corps of Engineers proposed method.
- e - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska.
- f - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

Table 2-4
LANDFILL
SAMPLE COLLECTION SUMMARY
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
SEDIMENT

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
24 (2 background)	VOC (SW-846 ^a Method 8260)	2 2-oz. glass jar w/Teflon-lined lid	4°C	1 trip blank/shipment 2 field duplicate, 2 lab QC sample
24 (2 background)	TAL Metals (SW-846 6010 and 7000 series methods)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicate, 2 lab QC sample
24 (2 background)	Semi-VOC (SW-846 Method 8270)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicate, 2 lab QC sample
24 (2 background)	Pesticide/PCBs (SW-846 Method 8080)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicate, 2 lab QC sample
24 (2 background)	Chlorinated herbicides SW-846 Method 8150)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicate, 2 lab QC sample
24 (2 background)	Petroleum hydrocarbon classification (SW-846 Modified Method 8015) ^d	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicate, 2 lab QC sample
24 (2 background)	TOC (SW-846 Method 9060)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicate, 2 lab QC sample
4 (1 background)	Sediment Toxicity Tests (ASTM ^b E 1391-90) (ASTM E 1383-90)	2 1-liter wide mouth polyethylene containers	4°C	2 lab QC sample
1	Grain size (ASTM D412, D422)	1 quart glass jar with Teflon-lined lid	None	None
3	Nitrate/nitrite (EPA ^c 353.2)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate 1 lab QC sample
1	Gas-Range Organics (ADEC Modified Method 8015) ^e	Two 2-oz glass jars with Teflon-lined lids	4°C	None
1	Diesel Range Organics (ADEC Method AK.102) ^f	4-oz glass jar with Teflon-lined lid	4°C	None

PCB - polychlorinated biphenyls

QC - quality control

TOC - total organic carbon

TCLP - toxicity characteristic leaching procedure

VOC - volatile organic compounds

TAL - target analyte list

a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.

b - Methods are contained in American Standards for Testing Materials (ASTM).

c - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.

Table 2-4 (Cont.)

- d - The modification of Method 8015 will be the United States Army Corps of Engineers proposed method.
- e - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska.
- f - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

Table 2-5 LANDFILL MONITORING WELL LIST FORT WAINWRIGHT, OPERABLE UNIT 4 FAIRBANKS, ALASKA				
Well	Completion Depth (feet bgs)	Type	Construction	Rationale
MW-1	200	Monitoring well	4" PVC	Background/upgradient
MW-2	200	Monitoring well	4" PVC	Background/upgradient
MW-3	200	Monitoring well	4" PVC	Background/upgradient
MW-4	15	Monitoring well	2" PVC	Determine extent of contamination and vertical component of flow.
MW-5	200	Monitoring well	4" PVC	Determine extent of contamination.
MW-6	200	Monitoring well	4" PVC	Determine extent of contamination.
MW-7	200	Monitoring well	4" PVC	Determine vertical component of flow.
MW-8	15	Monitoring well	2" PVC	Hydrogeology and determine extent of contamination.
MW-9	200	Monitoring well	4" PVC	Define vertical component of flow.
MW-10	15	Monitoring well	2" PVC	Hydrogeology and determine extent of contamination.
MW-11	15	Monitoring well	2" PVC	Determine extent of contamination southeast of the former trenches.

PVC - polyvinyl chloride

Table 2-6 EXISTING WELLS AT THE LANDFILL FORT WAINWRIGHT, OPERABLE UNIT 4 FAIRBANKS, ALASKA				
	Depth (feet bgs)	Screened (feet bgs)	Diameter (inches inner diameter)	Date Drilled
AP-5585	27.5	7-27	2	1990
AP-5588	29	7-27	2	1990
AP-5589	69	46-57.5	2	1990
AP-5591	29	8.5-24	2	1990
AP-5593	31.5	14.5-30.5	2	1990
AP-5594	54	43-53	2	1990
AP-5595	84	73.5-83.5	2	1990
W-LF-1	36.6	18.5-36.6	8	1988
W-LF-2	31.5	20-29	2	1988
W-LF-3	31.5	20.5-29.5	2	1988
FWLF-2	19	NA	2	1984
FWLF-3	24	NA	2	1984
FWLF-4	24	NA	2	1984

NA - not available

Table 2-7
LANDFILL
SAMPLE COLLECTION SUMMARY
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
GROUNDWATER

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
24 (Proposed and existing wells) (3 background)	VOC (SW-846 ^a Method 8260)	Two 40-mL glass VOA vials with Teflon-lined septa	2 drops concentrated HCl; 4°C	1 field blank/day 2 field duplicates, 2 lab QC samples, 1 equipment rinsate/day 1 trip blank/shipment
24 (3 background)	Semivolatile organic compounds (SW-846 Method 8270) + tetrahydrofuran	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicates, 2 lab QC samples, 1 equipment rinsate/day
24 (3 background)	Pesticide/PCBs (SW-846 Method 608)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicates, 2 lab QC samples, 1 equipment rinsate/day
24 (3 background)	Chlorinated herbicides (SW-846 Method 8150)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicates, 2 lab QC samples, 1 equipment rinsate/day
24 (3 background)	Petroleum hydrocarbon classification (SW-846 Modified Method 8015) ^d	1-liter amber glass bottle with Teflon-lined lid	4°C	2 field duplicates, 2 lab QC samples, 1 equipment rinsate/day
24 (3 background)	TRPH (EPA ^b 418.1)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C HCl to pH < 2	2 field duplicates, 2 lab QC samples, 1 equipment rinsate/day
24 (3 background)	Priority pollutant metals and barium (EPA 200 series)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2	2 field duplicates, 2 lab QC samples, 1 equipment rinsate/day
24 (3 background)	Dissolved priority pollutant metals and barium (EPA 200 series)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2 (filtered)	2 field duplicates, 2 lab QC samples
24 (3 background)	Total dissolved solids (EPA 160.1), alkalinity (EPA 310.1)	1-liter polyethylene bottle with polyethylene-lined lid	4°C	2 lab QC samples

<p align="center">Table 2-7</p> <p align="center">LANDFILL</p> <p align="center">SAMPLE COLLECTION SUMMARY</p> <p align="center">FORT WAINWRIGHT, OPERABLE UNIT 4</p> <p align="center">FAIRBANKS, ALASKA</p> <p align="center">GROUNDWATER</p>				
Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
1	Gas-Range Organics (ADEC Modified Method 8015) ^e	Three 40-mL glass VOA vials with Teflon-lined septa	HCl to pH <2; 4°C	None
1	Diesel-Range Organics (ADEC Method AK.102) ^f	1-liter amber glass bottle with Teflon-lined lid	HCl to pH <2; 4°C	None
24 (3 background)	TOC (EPA 415.1)	Two 1-liter amber glass bottles with Teflon-lined lids	HCl to pH < 2; 4°C	2 field duplicates, 2 lab QC samples
24 (3 background)	Major cations (I-1472-85°), potassium (I-1630-85)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2; 4°C (filtered)	2 lab QC samples
24 (3 background)	Major anions (I-2058-85°)	1-liter polyethylene bottle with polyethylene-lined lid	4°C (filtered)	2 lab QC samples
24 (3 background)	BOD (EPA 405.1)	1-liter polyethylene bottle with polyethylene-lined lid	4°C	2 lab QC samples
24 (3 background)	Nitrate/Nitrite (EPA 353.2)	1-liter polyethylene bottle with polyethylene-lined lid; field rinsed	H ₂ SO ₄ to pH <1	2 lab QC samples
24 (3 background)	Explosive Residue (EPA Method 8330)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicates 2 QC samples 1 equipment rinsate/day

PCB - polychlorinated biphenyls

QC - quality control

TRPH - total recoverable petroleum hydrocarbons

TOC - total organic carbon

VOC - volatile organic compounds

VOA - volatile organic analytes

BOD - biological oxygen demand

a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.

b - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.

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- c - Methods are contained in USGS Methods for Determination of Inorganic Substances in Water and Fluvial Sediment, 1989.
- d - The modification of Method 8015 will be the United States Army Corps of Engineers proposed method.
- e - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska.
- f - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

<p align="center">Table 2-8</p> <p align="center">LANDFILL</p> <p align="center">SAMPLE COLLECTION SUMMARY</p> <p align="center">FORT WAINWRIGHT, OPERABLE UNIT 4</p> <p align="center">FAIRBANKS, ALASKA</p> <p align="center">ASH</p>				
Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
8	TAL Metals (SW-846 ^a Method 6010 and 7000 series methods)	8-oz. glass jar with Teflon-lined lid	4°C	1 lab QC sample, 1 field replicates
8	Semivolatile organic compounds (SW-846 Method 8270)	8-oz. glass jar with Teflon-lined lid	4°C	1 lab QC sample, 1 field replicates
8	Dioxin (SW-846 Method 8290)	8-oz. glass jar with Teflon-lined lid	4°C	1 lab QC sample, 1 field replicates
8	Pesticides/PCB (SW-846 Method 8080)	8-oz. glass jar with Teflon-lined lid	4°C	1 lab QC sample, 1 field replicates
8	Chlorinated herbicides (SW-846 Method 8150)	8-oz. glass jar with Teflon-lined lid	4°C	1 lab QC sample, 1 field replicates
4	Grain size (ASTM ^b D412, D422)	1 quart jar with teflon-lined lid	None	None

PCB - polychlorinated biphenyls
 QC - quality control

a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.

b - Methods are contained in American Standards for Testing Materials (ASTM).

<p align="center">Table 2-9</p> <p align="center">LANDFILL</p> <p align="center">SAMPLE COLLECTION SUMMARY</p> <p align="center">FORT WAINWRIGHT, OPERABLE UNIT 4</p> <p align="center">FAIRBANKS, ALASKA</p> <p align="center">AIR</p>				
Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
21	TAL Metals (SW-846 ^a Method 6010, 7000 series)	Ashless filter paper placed in folder or plastic bag	None	6 field replicates

TAL - target analyte list

QC - quality control

a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.

Table 2-10

**POWER PLANT COAL STORAGE YARD
SAMPLE COLLECTION SUMMARY
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
SURFACE SOIL**

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
6 (1 background)	VOC (SW-846 ^a Method 8260)	Two 2-oz. glass VOA jars with Teflon-lined septa	4°C	1 field duplicate, 1 lab QC sample 1 trip blank/shipment
6 (1 background)	Petroleum Hydrocarbon Classification (SW-846 Modified Method 8015 ^b)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 1 lab QC sample
6 (1 background)	TOC (SW-846 Method 9060)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 1 lab QC sample
6 (1 background)	TRPH (EPA ^c 418.1)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 1 lab QC sample
6 (1 background)	Pesticide/PCBs (SW-846 Method 8080)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 1 lab QC sample
6 (1 background)	Chlorinated herbicides (SW-846 Method 8150)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 1 lab QC sample
6 (1 background)	Target Analyte List metals (SW-846 Method 7000 series)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 1 lab QC sample
6 (1 background)	Semivolatile organic compounds (SW-846 Method 8270)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 1 lab QC sample
6 (1 background)	Dioxin (SW-846 Method 8290)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 1 lab QC sample
4	Atterberg limits (ASTM D4318 ^d), specific gravity (ASTM D854), moisture content (ASTM D2216), grain size ((ASTM D421, D422)	1-quart glass jar with Teflon-lined lid	None	None
4	Nitrate/nitrite (EPA 353.2), phosphorus (EPA 365.2)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate 1 lab QC sample
4	TCLP (extraction SW-846 Method 1311, see individual analyses)	8-oz. glass jar with Teflon-lined lid	Archive	1 field duplicate 1 lab QC sample
1	Gas-Range Organics (ADEC Modified Method 8015) ^e	Two 2-oz glass jars with Teflon-lined lids	4°C	None
1	Diesel-Range Organics (ADEC Method AK.102) ^f	4-oz glass jar with Teflon-lined lid	4°C	None

Table 2-10 (Cont.)

PCB - polychlorinated biphenyls
QC - quality control
TRPH - total recoverable petroleum hydrocarbons
TOC - total organic carbon

VOC - volatile organic compounds
VOA - volatile organic analytes
TCLP - toxicity characteristic leaching procedure

- a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.
- b - The modification of Method 8015 will be the United States Army Corps of Engineers proposed method.
- c - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.
- d - Methods are contained in American Standards for Testing Materials (ASTM).
- e - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska.
- f - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

Table 2-11

**POWER PLANT COAL STORAGE YARD
SAMPLE COLLECTION SUMMARY
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
SUBSURFACE SOIL**

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
8 monitoring wells/ boreholes (1 background)	VOC (SW-846 ^a Method 8260)	Two 2-oz. glass VOA vials with Teflon-lined septa	4°C	1 trip blank/shipment 2 field duplicates, 2 lab QC samples, 1 equipment rinsate/day
8 (1 background)	Petroleum Hydrocarbon Classification (SW-846 Modified Method 8015 ^b)	8-oz. glass jar with Teflon-lined lid	4°C	2 lab QC sample, 2 field duplicate 1 equipment rinsate/day
8 (1 background)	TOC (SW-846 Method 9060)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicates 2 lab QC samples, 1 equipment rinsate/day
8 (1 background)	TRPH (EPA ^c 418.1)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicates, 2 lab QC sample, 1 equipment rinsate/day
8 (1 background)	Pesticides/PCBs (SW-846 Method 8080)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicates, 2 lab QC sample, 1 equipment rinsate/day
8 (1 background)	Chlorinated herbicides (SW-846 Method 8150)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicates, 2 lab QC sample, 1 equipment rinsate/day
8 (1 background)	TAL metals, (SW-846 6010 and 7000 series methods)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicates, 2 lab QC samples, 1 equipment rinsate/day
8 (1 background)	Semivolatile organic compounds (SW-846 Method 8270)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicates, 2 lab QC samples, 1 equipment rinsate/day
8 (1 background)	Dioxin (SW-846 Method 8290)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicates, 2 lab QC samples
1	Gas-Range Organics (ADEC Modified Method 8015) ^e	Two 2-oz glass jars with Teflon-lined lids	4°C	None
1	Diesel-Range Organics (ADEC Method AK.102) ^f	4-oz glass jar with Teflon-lined lid	4°C	None

Table 2-11

**POWER PLANT COAL STORAGE YARD
SAMPLE COLLECTION SUMMARY
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
SUBSURFACE SOIL**

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
4	Atterberg limits (ASTM D4318 ^d), specific gravity (ASTM D854), moisture content (ASTM D2216), grain size (ASTM D421, D422)	1-quart glass jar with Teflon-lined lid	None	None
4	Nitrate/nitrite (EPA 353.2), phosphorous (EPA 365.2)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate 1 lab QC sample
4	TCLP (extraction by SW-846 Method 1311, see individual analyses)	8-oz. glass jar with Teflon-lined lid	Archive	1 field duplicate 1 lab QC sample

PCB - polychlorinated biphenyls

QC - quality control

TAL - target analyte list

TCLP - toxicity characteristic leaching procedure

TRPH - total recoverable petroleum hydrocarbons

TOC - total organic carbon

VOC - volatile organic compounds

VOA - volatile organic analytes

- a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.
- b - The modification of Method 8015 will be the United States Army Corps of Engineers proposed method.
- c - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.
- d - Methods are contained in American Standards for Testing Materials (ASTM).
- e - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska.
- f - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

Table 2-12
POWER PLANT COAL STORAGE YARD
SAMPLE COLLECTION SUMMARY
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
SURFACE WATER

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
7 (1 background)	VOC (SW-846 ^a Method 8260)	Two 40-mL glass VOA vials with Teflon-lined septa	2 drops concentrated HCl; 5 (1 background)°C	1 field duplicate, 1 lab QC sample 1 trip blank/shipment
7 (1 background)	Semivolatile organic compounds (SW- 846 Method 8270)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	1 field duplicate, 1 lab QC sample
7 (1 background)	Pesticides/PCB (SW-846 Method 8080)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	1 field duplicate, 1 lab QC sample
7 (1 background)	Chlorinated herbicides (SW-846 Method 8150)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	1 field duplicate, 1 lab QC sample
7 (1 background)	Dioxins (SW-846 Method 8290)	Two 1-liter amber glass bottle with Teflon-lined lids	4°C	1 field duplicate, 1 lab QC sample
7 (1 background)	Petroleum hydrocarbon classification (SW- 846 Modified Method 8015 ^b)	1-liter amber glass bottle with Teflon- lined lid	4°C	1 field duplicate, 1 lab QC sample
1	Gas-Range Organics (ADEC Modified Method 8015) ^c	Three 40-mL glass VOA vials with Teflon-lined septa	HCl to pH <2; 4°C	None
1	Diesel-Range Organics (ADEC Method AK.102) ^f	1-liter amber glass bottle with Teflon- lined lid	HCl to pH <2; 4°C	None
7 (1 background)	TRPH (EPA ^c 418.1)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C HCl to pH <2	1 field duplicate, 1 lab QC sample
7 (1 background)	Priority pollutant metals and barium (EPA 200 series)	1-liter polyethylene bottle with polyethylene-lined lids	HNO ₃ to pH < 2	1 field duplicate, 1 lab QC sample
7 (1 background)	Dissolved priority pollutant metals and barium (EPA 200 series)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2 (filtered)	1 field duplicate, 1 lab QC sample

<p align="center">Table 2-12</p> <p align="center">POWER PLANT COAL STORAGE YARD</p> <p align="center">SAMPLE COLLECTION SUMMARY</p> <p align="center">FORT WAINWRIGHT, OPERABLE UNIT 4</p> <p align="center">FAIRBANKS, ALASKA</p> <p align="center">SURFACE WATER</p>				
Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
7 (1 background)	Total dissolved solids (EPA 160.1), alkalinity (EPA 310.1)	1-liter polyethylene bottle with polyethylene-lined lid	4°C	1 lab QC sample
7 (1 background)	Major cations (I-1472-85 ^d)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2; 4°C (filtered)	1 lab QC sample
7 (1 background)	Major anions (I-2058-85 ^e)	1-liter polyethylene bottle with polyethylene-lined lid	4°C (filtered)	1 lab QC sample
7 (1 background)	Nitrate/nitrite (EPA 353.2)	1-liter polyethylene bottle with polyethylene-lined lid; field rinsed	H ₂ SO ₄ to pH < 2; 4°C	1 field duplicate 1 lab QC sample

PCB - polychlorinated biphenyls
 QC - quality control
 VOC - volatile organic compounds
 VOA - volatile organic analytes

KEY:

- a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.
- b - The modification of Method 8015 will be the United States Army Corps of Engineers proposed method.
- c - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.
- d - Methods are contained in USGS Methods for Determination of Inorganic Substances in Water and Fluvial Sediments, 1989.
- e - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska.
- f - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

<p align="center">Table 2-13</p> <p align="center">POWER PLANT COAL STORAGE YARD</p> <p align="center">SAMPLE COLLECTION SUMMARY</p> <p align="center">FORT WAINWRIGHT, OPERABLE UNIT 4</p> <p align="center">FAIRBANKS, ALASKA</p> <p align="center">SEDIMENT</p>				
Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
10 (1 background)	VOC (SW-846 ^a Method 8260)	Two 40-mL glass VOA vials with Teflon-lined septa	4°C	1 field duplicate, 2 lab QC sample 1 trip blank/shipment
10 (1 background)	Petroleum hydrocarbon classification (SW-846 Modified Method 8015 ^b)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 2 lab QC sample
10 (1 background)	TOC (SW-846 Method 9060)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 2 lab QC sample
10 (1 background)	TRPH (EPA ^c 418.1)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 2 lab QC sample
10 (1 background)	Semi-VOCs (SW-846 Method 8270)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 2 lab QC sample
10 (1 background)	TAL Metals (SW-846 6010 and 7000 series methods)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 2 lab QC sample
10 (1 background)	Pesticide/PCBs (SW-846 Method 8080)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 2 lab QC sample
10 (1 background)	Chlorinated herbicides (SW-846 Method 8150)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 2 lab QC sample
10 (1 background)	Dioxin (SW-846 Method 8290)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate, 2 lab QC sample
1	Gas-Range Organics (ADEC Modified Method 8015) ^d	Two 2-oz glass jars with Teflon-lined lids	4°C	None
1	Diesel-Range Organics (ADEC Method AK.102) ^e	4-oz glass jar with Teflon-lined lid	4°C	None

PCB - polychlorinated biphenyls
 QC - quality control
 TRPH - total recoverable petroleum hydrocarbons
 TOC - total organic carbon

VOC - volatile organic compounds
 VOA - volatile organic analytes

^a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.

Table 2-13 (Cont.)

- b - The modification of Method 8015 will be the United States Army Corps of Engineers proposed method.
- c - Method is contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.
- d - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska.
- e - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

Table 2-14

**POWER PLANT COAL STORAGE YARD
PROPOSED MONITORING WELLS
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA**

Well	Completion Depth (feet bgs)	Type	Construction	Rationale
MW-1	30	Monitoring well	2" PVC	Upgradient/define hydrology/background
MW-2	30	Piezometer	2" PVC	Vertical component of groundwater flow
MW-3	60	Piezometer	2" PVC	Vertical component of groundwater flow
MW-4	30	Monitoring well	2" PVC	Hydrogeology and define extent of contamination in CSY

PVC - Polyvinyl chloride

CSY - Power Plant Coal Storage Yard

Table 2-15				
EXISTING WELLS AT THE CSY				
Well	Depth (feet bgs)	Screened Interval (feet bgs)	Internal Diameter (inches)	Drilling Date
AP-5734	20.0	8.4 - 18.4	2	1992
AP-5735	20.0	8.4 - 18.4	2	1992
AP-5736	23.6	13.1 - 23.1	2	1992
AP-5505	17.0	7 - 17*	2	1986
AP-5506	18.0	8 - 18*	2	1986
AP-5508	19.0	8.3 - 18.3*	2	1986
AP-5509	15.0	9 - 14*	2	1986
AP-5510	10.0	1 - 6*	2	1986
AP-5511	10.0	2.9 - 7.9*	2	1986
AP-5512	20.0	8.4 - 18.4*	2	1986
AP-5517	24.4	14.1 - 24.1*	2	1989
AP-4856	19	NA	NA	1985
AP-4912	24	NA	NA	1985
119	NA	NA	NA	NA
99	NA	NA	NA	NA
124	204	NA	18	NA
3559A	NA	NA	NA	NA
3559B	NA	NA	NA	NA
3595	179	NA	18	NA

* - Estimate

Table 2-16

**POWER PLANT COAL STORAGE YARD
SAMPLE COLLECTION SUMMARY
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
GROUNDWATER**

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
23 (1 background)	VOC (SW-846 ^a Method 8260)	Two 40-mL glass VOA vials with Teflon-lined septa	2 drops concentrated HCl; 4°C	1 field blank/day 2 field duplicates, 2 lab QC samples, 1 equipment rinsate/day 1 trip blank/shipment
6	Water Supply Wells (EPA Method 524) ^b	Three 40-mL glass VOA vials with Teflon-lined septa	2 drops concentrated HCl; 4°C	1 field blank/day 1 field duplicates, 1 lab QC samples, 1 trip blank/shipment
23 (1 background)	Semivolatile organic compounds (SW- 846 Method 8270)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicates, 2 lab QC sample, 1 equipment rinsate/day
6	Water Supply Well Semi-VOCs (EPA Method 525) ^b	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	1 field duplicates, 1 lab QC sample, 1 equipment rinsate/day
23 (1 background)	Pesticide/PCBs (SW-846 Method 8080)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicates, 2 lab QC sample, 1 equipment rinsate/day
23 (1 background)	Chlorinated herbicides (SW-846 Method 8150)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicates, 2 lab QC sample, 1 equipment rinsate/day
6	EPA-DW Method 505 ^b	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	1 field duplicate 1 QC sample
23 (1 background)	Dioxin (SW-846 Method 8290)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	3 field duplicates, 3 lab QC sample, 1 equipment rinsate/day
23 (1 background)	Petroleum hydrocarbon classification (SW-846 Modified Method 8015 ^c)	1-liter amber glass bottle with Teflon-lined lid	4°C	3 field duplicates, 3 lab QC samples, 1 equipment rinsate/day
23 (1 background)	TRPH (EPA ^d 418.1)	Two 1-liter amber glass bottle with Teflon-lined lids	4°C HCl to pH < 2	3 field duplicates, 3 lab QC samples, 1 equipment rinsate/day

Table 2-16
POWER PLANT COAL STORAGE YARD
SAMPLE COLLECTION SUMMARY
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
GROUNDWATER

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
1	Gas-Range Organics (ADEC Modified Method 8015) ^f	Three 40-mL glass VOA vials with Teflon-lined septa	HCl to pH < 2; 4°C	None
1	Diesel-Range Organics (ADEC Method AK.102) ^g	1-liter amber glass bottle with Teflon-lined lid	HCl to pH < 2; 4°C	None
23 (1 background)	Priority pollutant metals and barium (EPA 200 series)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2	3 field duplicates, 3 lab QC sample, 1 equipment rinsate/day
23 (1 background)	Dissolved priority pollutant metals and barium (EPA 200 series)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2 (filtered)	3 field duplicates, 3 lab QC samples
23 (1 background)	Total dissolved solids (EPA 160.1), alkalinity (EPA 310.1)	1-liter polyethylene bottle with polyethylene-lined lid	4°C	3 lab QC samples
23 (1 background)	TOC (EPA 415.1)	Two 1-liter amber glass bottles with Teflon-lined lids	HCl to pH < 2; 4°C	3 field duplicates, 3 lab QC samples
23 (1 background)	Major cations (I-1472-85 ^e)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2; 4°C (filtered)	3 lab QC samples
23 (1 background)	Major anions (I-2058-85)	1-liter polyethylene bottle with polyethylene-lined lid	4°C (filtered)	3 lab QC samples
23 (1 background)	BOD (EPA 405.1)	1-liter polyethylene bottle with polyethylene-lined lid	4°C	3 lab QC samples
23 (1 background)	Nitrate/nitrite	1-liter polyethylene bottle with polyethylene-lined lid; field rinsed	H ₂ SO ₄ to pH < 2; 4°C	None

PCB - polychlorinated biphenyls

QC - quality control

TRPH - total recoverable petroleum hydrocarbons

TOC - total organic carbon

TCLP - toxicity characteristic leaching procedure

VOC - volatile organic compounds

VOA - volatile organic analytes

a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.

Table 2-16 (Cont.)

- b - Methods are contained in "Methods for the Determination of Organic Compounds in Drinking Water", EPA-600/4-88/039, December 1988.
- c - The modification of Method 8015 will be the United States Army Corps of Engineers proposed method.
- d - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.
- e - Methods are contained in USGS Method for Determination of Inorganic Substances in Water and Fluvial Sediment, 1989.
- f - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska.
- g - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

Table 2-17

**FIRE TRAINING PITS
SAMPLE COLLECTION SUMMARY
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
SURFACE SOIL**

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
56 (3 background)	VOC (SW-846 ^a Method 8260)	Two 2-oz. glass VOA vials with Teflon-lined septa	4°C	6 field duplicates, 6 lab QC sample 1 trip blank/shipment
56 (3 background)	Petroleum Hydrocarbon Classification (SW-846 Modified Method 8015 ^b)	8-oz. glass jar with Teflon-lined lid	4°C	6 field duplicates, 6 lab QC samples
3	Gas-Range Organics (ADEC Modified Method 8015 ^c)	Two 2-oz glass jars with Teflon-lined lids	4°C	None
3	Diesel-Range Organics (ADEC Method AK.102) ^f	4-oz glass jar with Teflon-lined lid	4°C	None
56 (3 background)	TOC (SW-846 Method 9060)	8-oz. glass jar with Teflon-lined lid	4°C	6 field duplicates, 6 lab QC samples
56 (3 background)	TRPH (EPA ^c 418.1)	8-oz. glass jar with Teflon-lined lid	4°C	6 field duplicates, 6 lab QC samples
56 (3 background)	Target Analyte List metals (SW-846 Method 6010, 7000 series)	8-oz. glass jar with Teflon-lined lid	4°C	6 field duplicates, 6 lab QC samples
56 (3 background)	Semivolatile organic compounds (SW-846 Method 8270)	8-oz. glass jar with Teflon-lined lid	4°C	6 field duplicates, 6 lab QC samples
56 (3 background)	Pesticide/PCBs (SW-846 Method 8080)	8-oz. glass jar with Teflon-lined lid	4°C	6 field duplicates, 6 lab QC samples
56 (3 background)	Chlorinated herbicides (SW-846 Method 8150)	8-oz. glass jar with Teflon-lined lid	4°C	6 field duplicates, 6 lab QC samples
56 (3 background)	Dioxins (SW-846 Method 8290)	8-oz. glass jar with Teflon-lined lid	4°C	6 field duplicates, 6 lab QC samples
4	Atterberg limits (ASTM D4318 ^d), specific gravity (ASTM D854), moisture content (ASTM D2216), grain size ((ASTM D421, D422)	1-quart glass jar with Teflon-lined lid	None	None
4	Nitrate/nitrite (EPA 353.2), phosphorus (EPA 365.2)	8-oz. glass jar with Teflon-lined lid	4°C	None

Table 2-17

**FIRE TRAINING PITS
SAMPLE COLLECTION SUMMARY
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
SURFACE SOIL**

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
4	TCLP (extraction SW-846 Method 1311, see individual analyses)	8-oz. glass jar with Teflon-lined lid	Archive	1 field duplicate 1 lab QC sample

PCB - polychlorinated biphenyls

QC - quality control

TOC - total organic carbon

TCLP - toxicity characteristic leaching procedure

TRPH - total recoverable petroleum hydrocarbons

VOC - volatile organic compounds

VOA - volatile organic analytes

- a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.
- b - The modification of Method 8015 will be the United States Army Corps of Engineers proposed method.
- c - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983
- d - Methods are contained in American Standards for Testing Materials (ASTM).
- e - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska.
- f - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

Table 2-18

**FIRE TRAINING PITS
SAMPLE COLLECTION SUMMARY
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
SUBSURFACE SOIL**

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
40 (20 monitoring wells/ boreholes)	VOC (SW-846 ^a Method 8260)	Two 2-oz. glass VOA vials with Teflon-lined septa	4°C	1 trip blank/shipment 4 field duplicates, 4 lab QC samples, 1 equipment rinsate/day
40 (3 background)	Petroleum Hydrocarbon Classification (SW-846 Modified Method 8015 ^b)	8-oz. glass jar with Teflon-lined lid	4°C	4 field duplicates, 4 lab QC sample, 1 equipment rinsate/day
2	Gas-Range Organics (ADEC Modified Method 8015) ^c	Two 2-oz glass jars with Teflon-lined lids	4°C	None
2	Diesel-Range Organics (ADEC Method AK.102) ^f	4-oz glass jar with Teflon-lined lid	4°C	None
40 (3 background)	TOC (SW-846 Method 9060)	8-oz. glass jar with Teflon-lined lid	4°C	4 field duplicates, 4 lab QC sample, 1 equipment rinsate/day
40 (3 background)	TRPH (EPA ^c 418.1)	8-oz. glass jar with Teflon-lined lid	4°C	4 field duplicates, 4 lab QC sample, 1 equipment rinsate/day
40 (3 background)	Target Analyte List metals, (SW-846 6010, 7000 series methods)	8-oz. glass jar with Teflon-lined lid	4°C	4 field duplicate, 4 lab QC sample, 1 equipment rinsate/day
40 (3 background)	Semivolatile organic compounds (SW-846 Method 8270)	8-oz. glass jar with Teflon-lined lid	4°C	4 field duplicate, 4 lab QC sample, 1 equipment rinsate/day
40 (3 background)	Pesticides/PCBs (SW-846 Method 8080)	8-oz. glass jar with Teflon-lined lid	4°C	4 field duplicates, 4 lab QC samples, 1 equipment rinsate/day
40 (3 background)	Chlorinated herbicides (SW-846 Method 8150)	8-oz. glass jar with Teflon-lined lid	4°C	4 field duplicates, 4 lab QC samples, 1 equipment rinsate/day
40 (3 background)	Dioxins (SW-846 Method 8290)	8-oz. glass jar with Teflon-lined lid	4°C	4 field duplicates, 4 lab QC samples, 1 equipment rinsate/day

Table 2-18

**FIRE TRAINING PITS
SAMPLE COLLECTION SUMMARY
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
SUBSURFACE SOIL**

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
4	Atterberg limits (ASTM D4318 ^d), specific gravity (ASTM D854), moisture content (ASTM D2216), grain size ((ASTM D421, D422)	1-quart glass jar with Teflon-lined lid	None	None
4	Nitrate/nitrite (EPA 353.2), phosphorous (EPA 365.2)	8-oz. glass jar with Teflon-lined lid	4°C	None
4	TCLP (extraction SW-846 Method 1311, see individual analyses)	8-oz. glass jar with Teflon-lined lid	4°C	1 field duplicate 1 lab QC sample

PCB - polychlorinated biphenyls
QC - quality control
TOC - total organic carbon

TRPH - total recoverable petroleum hydrocarbons
VOC - volatile organic compounds
VOA - volatile organic analytes

- a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.
- b - The modification of Method 8015 will be the United States Army Corps of Engineers proposed method.
- c - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.
- d - Methods are contained in American Standards for Testing Materials (ASTM).
- e - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska.
- f - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

Table 2-19

**SAMPLE COLLECTION SUMMARY
FIRE TRAINING PITS
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
SURFACE WATER**

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
15 (3 background)	VOC (SW-846 ^a Method 8260)	Two 40-mL glass VOA vials with Teflon-lined septa	2 drops concentrated HCl; 4°C	1 field blank/day 2 field duplicate, 2 lab QC samples 1 trip blank/shipment
15 (3 background)	Semivolatile organic compounds (SW- 846 Method 8270)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicate, 2 lab QC samples
15 (3 background)	Pesticide/PCBs (EPA ^b Method 608)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicate, 2 lab QC samples
15 (3 background)	Chlorinated herbicides (SW-846 Method 8150)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicate, 2 lab QC samples
15 (3 background)	Dioxins (SW-846 Method 8290)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicate, 2 lab QC samples
15 (3 background)	Petroleum hydrocarbon classification (SW-846 Modified Method 8015 ^c)	1-liter amber glass bottle with Teflon- lined lid	4°C	2 field duplicate, 2 lab QC samples
1	Gas-Range Organics (ADEC Modified Method 8015) ^e	Three 40-mL glass VOA vials with Teflon-lined septa	HCl to pH <2; 4°C	None
1	Diesel-Range Organics (ADEC Method AK.102) ^f	1-liter amber glass bottle with Teflon- lined lid	HCl to pH <2; 4°C	None
15 (3 background)	TRPH (EPA ^g 418.1)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C HCl to pH <2	2 field duplicate, 2 lab QC samples
15 (3 background)	Priority pollutant metals and barium (EPA 200 series)	Two 1-liter polyethylene bottle with polyethylene- lined lids	HNO ₃ to pH < 2	2 field duplicate, 2 lab QC samples
15 (3 background)	Dissolved priority pollutant metals and barium (EPA 200 series)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2 (filtered)	2 field duplicate, 2 lab QC samples
15 (3 background)	Total dissolved solids (EPA 160.1), alkalinity (EPA 310.1)	1-liter polyethylene bottle with polyethylene-lined lid	4°C	2 lab QC samples

Table 2-19

**SAMPLE COLLECTION SUMMARY
FIRE TRAINING PITS
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
SURFACE WATER**

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
15 (3 background)	Major cations (I-1472-85 ^d)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2; 4°C (filtered)	2 lab QC samples
15 (3 background)	Major anions (I-2058-85 ^d)	1-liter polyethylene bottle with polyethylene-lined lid	4°C (filtered)	2 lab QC samples
15 (3 background)	Nitrate/nitrite (EPA 353.2)	250-ml brown polyethylene bottle with polyethylene- lined lid; field rinsed	H ₂ SO ₄ to pH < 2; 4°C	2 lab QC samples

PCB - polychlorinated biphenyls

QC - quality control

TPH - total petroleum hydrocarbons

TOC - total organic carbon

TCLP - toxicity characteristic leaching procedure

VOC - volatile organic compounds

VOA - volatile organic analytes

- a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.
- b - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.
- c - The modification of Method 8015 will be the United States Army Corps of Engineers proposed method.
- d - Methods are contained in "USGS Method for Determination of Inorganic Substances in Water and Fluvial Sediment", 1989.
- e - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska.
- f - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

Table 2-20

**SAMPLE COLLECTION SUMMARY
FIRE TRAINING PITS
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
SEDIMENT**

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
15 (3 background)	VOC (SW-846 ^a Method 8260)	Two 2-oz. glass VOA jars with Teflon-lined septa	4°C	1 trip blank/shipment, 2 field duplicate, 2 lab QC samples
15 (3 background)	Petroleum hydrocarbon classification (SW-846 Modified Method 8015 ^b)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicate, 2 lab QC samples
1	Gas-Range Organics (ADEC Modified Method 8015) ^d	Two 2-oz glass jars with Teflon-lined lids	4°C	None
1	Diesel-Range Organics (ADEC Method AK.102) ^e	4-oz glass jar with Teflon-lined lid	4°C	None
15 (3 background)	TOC (SW-846 Method 9060)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicate, 2 lab QC samples
15 (3 background)	TRPH (EPA ^c 418.1)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicate, 2 lab QC samples
15 (3 background)	Semi-VOCs (SW-846 Method 8270)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicate, 2 lab QC samples
15 (3 background)	TAL Metals (SW-846 6010, 7000 series methods)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicate, 2 lab QC samples
15 (3 background)	Pesticide/PCBs (SW-846 Method 8080)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicate, 2 lab QC samples
15 (3 background)	Chlorinated herbicides (SW-846 Method 8150)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicate, 2 lab QC samples
15 (3 background)	Dioxins (SW-846 Method 8290)	8-oz. glass jar with Teflon-lined lid	4°C	2 field duplicate, 2 lab QC samples

PCB - polychlorinated biphenyls

QC - quality control

TRPH - total recoverable petroleum hydrocarbons

TOC - total organic carbon

VOC - volatile organic compounds

VOA - volatile organic analytes

^a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.

^b - The modification of Method 8015 will be the United States Army Corps of Engineers proposed method.

^c - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983

^d - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska.

^e - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

Table 2-21

**FIRE TRAINING PITS
MONITORING WELL LIST
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA**

Well	Completion Depth	Type	Construction	Rationale
MW-1	30	Monitoring well	2" PVC	Upgradient/background at FTP 3A
MW-2	30	Monitoring well	2" PVC	Upgradient/background at FTP 3A
MW-3	30	Monitoring well	2" PVC	Upgradient/background at FTP 3B
MW-4	30	Monitoring well	4" PVC	Hydrogeology and nature and extent of contamination at FTP 3B
MW-5	30	Monitoring well	4" PVC	Hydrogeology and nature and extent of contamination at FTP 3B
MW-6	30	Monitoring well	4" PVC	Hydrogeology and nature and extent of contamination at FTP 3B
MW-7	30	Monitoring well	2" PVC	Hydrogeology and nature and extent of contamination, downgradient of FTP 3B
MW-8	30	Monitoring well	2" PVC	Hydrogeology and nature and extent of contamination, downgradient of FTP 3B
MW-9	30	Monitoring well	4" PVC	Hydrogeology and nature and extent of contamination of former drum area
MW-10	30	Monitoring well	2" PVC	Nature and extent of contamination at FTP 3A
MW-11	15	Piezometer	2" PVC	Define vertical groundwater component
MW-12	100	Piezometer	2" PVC	Define vertical groundwater component
MW-13	30	Monitoring well	4" PVC	Define vertical groundwater component

PVC - polyvinyl chloride

Table 2-22				
EXISTING WELLS AT THE FTPS				
Well	Depth (feet bgs)	Screened Interval (feet bgs)	Diameter (inch)	Date Drilled
AP-5295	25.0	NA	1.5	1987
AP-5312	25.0	NA	1.5	1987

Table 2-23
SAMPLE COLLECTION SUMMARY
FIRE TRAINING PITS
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
GROUNDWATER

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
15 (3 background)	VOC (SW-846 ^a Method 8260)	Two 40-mL glass VOA vials with Teflon-lined septa	2 drops concentrated HCl; 4°C	1 field blank/day 2 field duplicates, 2 lab QC sample, 1 equipment rinsate/day 1 trip blank/shipment
15 (3 background)	Semivolatile organic compounds (SW- 846 Method 8270)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicates, 2 lab QC sample, 1 equipment rinsate/day
15 (3 background)	Pesticide/PCBs (SW-846 Method 8080)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicates, 2 lab QC sample, 1 equipment rinsate/day
15 (3 background)	Chlorinated herbicides (SW-846 Method 8150)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicates, 2 lab QC sample, 1 equipment rinsate/day
15 (3 background)	Dioxins (SW-846 Method 8290)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	2 field duplicates, 2 lab QC sample, 1 equipment rinsate/day
15 (3 background)	Petroleum hydrocarbon classification (SW- 846 Modified Method 8015 ^b)	1-liter amber glass bottle with Teflon- lined lid	4°C	2 field duplicates, 2 lab QC sample, 1 equipment rinsate/day
15 (3 background)	TRPH (EPA ^c 418.1)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C HCL to pH <2	2 field duplicates, 2 lab QC sample, 1 equipment rinsate/day
15 (3 background)	Priority pollutant metals and barium (EPA 200 series)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2	2 field duplicates, 2 lab QC sample, 1 equipment rinsate/day
15 (3 background)	Dissolved priority pollutant metals and barium (EPA 200 series)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2 (filtered)	2 field duplicates, 2 lab QC sample
15 (3 background)	Total dissolved solids (EPA 160.1), alkalinity (EPA 310.1)	1-liter polyethylene bottle with polyethylene-lined lid	4°C	2 lab QC sample

Table 2-23

**SAMPLE COLLECTION SUMMARY
FIRE TRAINING PITS
FORT WAINWRIGHT, OPERABLE UNIT 4
FAIRBANKS, ALASKA
GROUNDWATER**

Quantity	Analytical Parameter	Container Type	Sample Preservative	Quality Assurance/ Quality Control
1	Gas-Range Organics (ADEC Modified Method 8015) ^e	Three 40-mL glass VOA vials with Teflon-lined septa	HCl to pH < 2; 4°C	None
1	Diesel-Range Organics (ADEC Method AK.102) ^f	1-liter amber glass bottle with Teflon-lined lid	HCl to pH < 2; 4°C	None
15 (3 background)	TOC (SW-846 Method 9060)	Two 1-liter amber glass bottles with Teflon-lined lids	HCl to pH < 2; 4°C	2 field duplicates, 2 lab QC sample
15 (3 background)	Major cations (I-1472-85 ^d), potassium (I-1630-85)	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2; 4°C (filtered)	2 lab QC sample
15 (3 background)	Major anions (I-2058-85 ^d)	1-liter polyethylene bottle with polyethylene-lined lid	4°C (filtered)	2 lab QC sample
15 (3 background)	BOD (EPA 405.1)	1-liter polyethylene bottle with polyethylene-lined lid	4°C	2 lab QC sample
15 (3 background)	Nitrate/nitrite (EPA 353.2)	250-mL brown polyethylene bottle with polyethylene-lined lid; field rinsed	H ₂ SO ₄ to pH < 2; 4°C	2 field duplicates 2 lab QC samples

PCB - polychlorinated biphenyls

QC - quality control

TOC - total organic carbon

TRPH - total recoverable petroleum hydrocarbons

VOC - volatile organic compounds

VOA - volatile organic analytes

a - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste," SW-846, Revision 0, September 1986.

b - The modification of Method 8015 will be the United States Army Corps of Engineers proposed method.

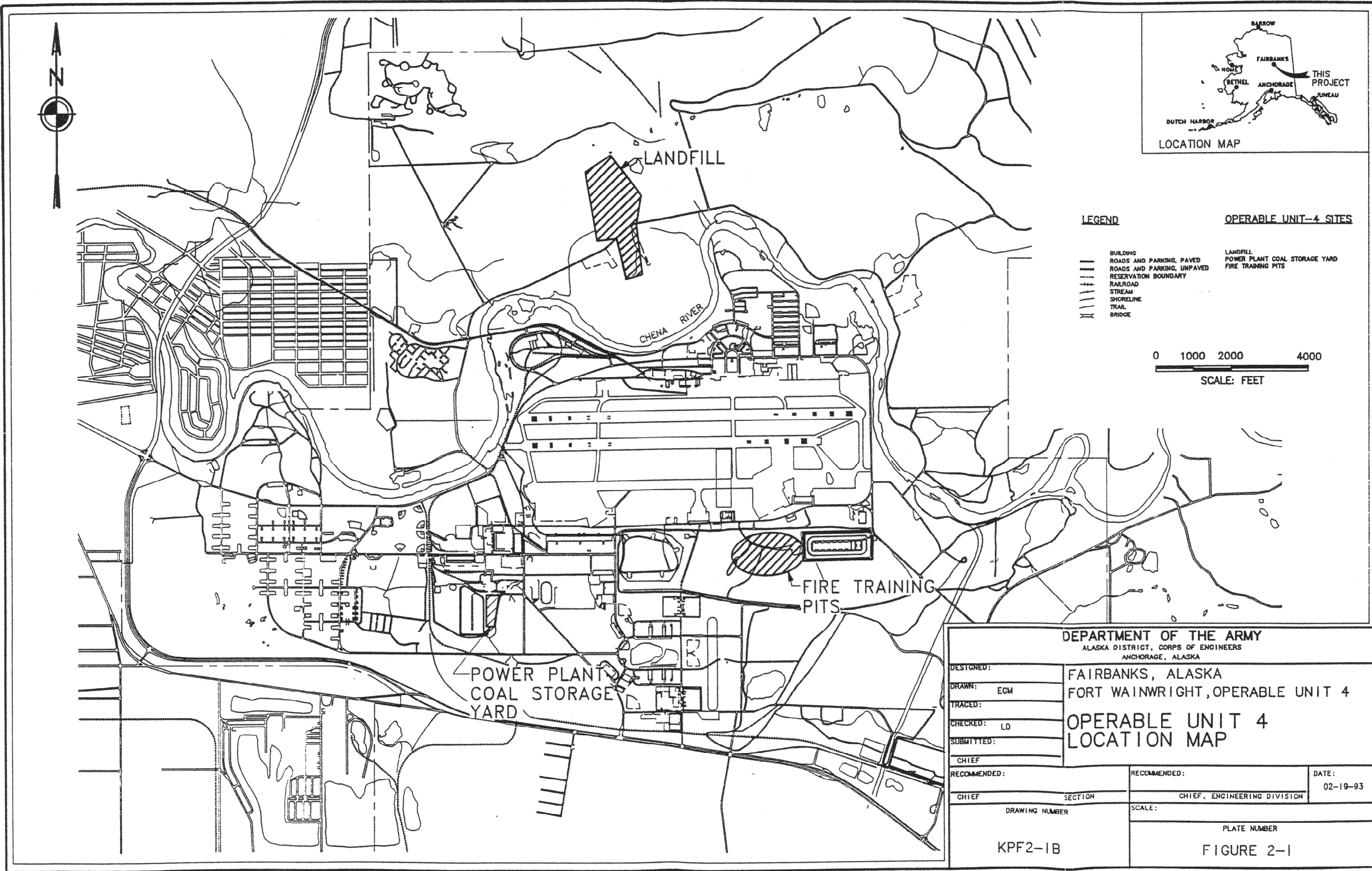
c - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.

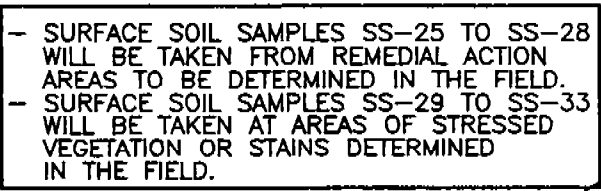
d - Methods are contained in USGS Methods for Determination of Inorganic Substances in Water and Fluvial Sediments, 1989.

e - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline-Range Organics, Revision 5, February 1992, Juneau, Alaska.

f - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics, Revision 2, February 5, 1993, Juneau, Alaska.

12439





Marshy area
Contour Interval
0.1 Feet

x Surface soil
sample



ALASKA DISTRICT, CORPS OF ENGINEERS
ANCHORAGE, ALASKA

የጽሑፍ ቅጽ

IS-2400N:

ECM

TRACED:

CHECKED:

SUMMARY

RECOMMENDER: *

CHIEF

FAIRBANKS, ALASKA

FORT WAINWRIGHT, OPERABLE UNIT 4

LANDFILL PROPOSED
SURFACE SOIL/ASH SAMPLE
LOCATION MAP

RECOMMENDED:

DATE:

04-20-93

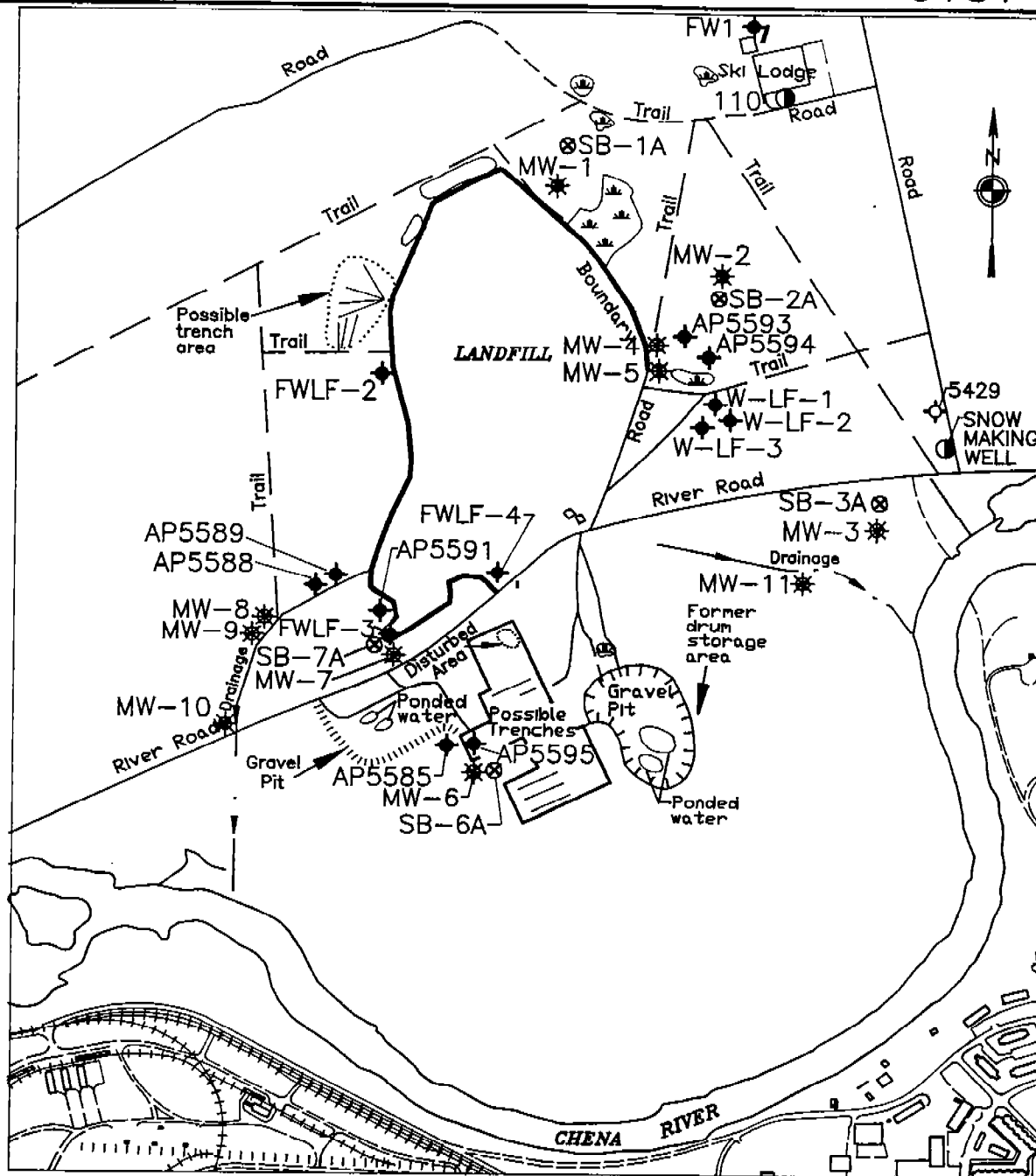
SCALE:

PLATE NUMBER

KQF2-2B, DWG

FIGURE 2-2

C:\CORP\KQ5200\KQF2-2B APR.20,1993

**LEGEND**

- Marshy area
- Existing well location
- Existing piezometer
- Proposed Monitoring well location/soil boring/surface soil sample
- Existing supply well
- Soil boring / surface soil sample
(SB-2A INDICATES AN ALTERNATE LOCATION, IF REQUIRED FOR INSTALLING A SUBPERMAFROST MONITORING WELL)

0 500 1000



Scale in Feet

Reference: E & E 1991

DEPARTMENT OF THE ARMYALASKA DISTRICT, CORPS OF ENGINEERS
ANCHORAGE, ALASKA

DESIGNED:

DRAWN:

EGM

TRACED:

CHECKED:

LD

SUBMITTED:

CHIEF

RECOMMENDED:

CHIEF

FAIRBANKS, ALASKA

FORT WAINWRIGHT, OPERABLE UNIT 4

**LANDFILL PROPOSED SOIL
BORING/MONITORING WELL
LOCATION MAP**

RECOMMENDED:

CHIEF, ENGINEERING DIVISION

DATE:

04-21-93

DRAWING NUMBER

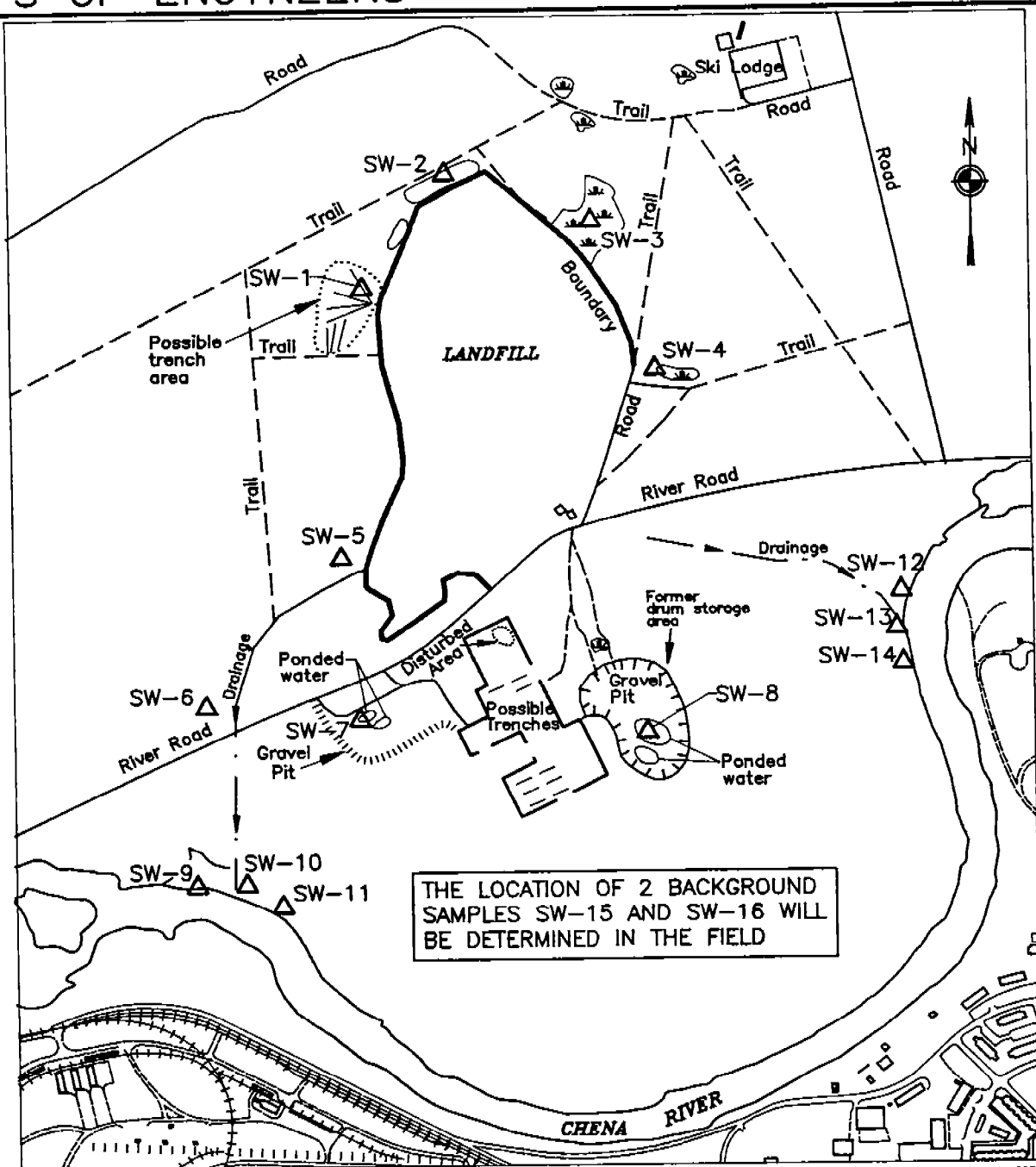
KQF2-3B.DWG

SCALE:

PLATE NUMBER

FIGURE 2-3

C:\C\15200\KQF2-3B APR.22,1993

**LEGEND**

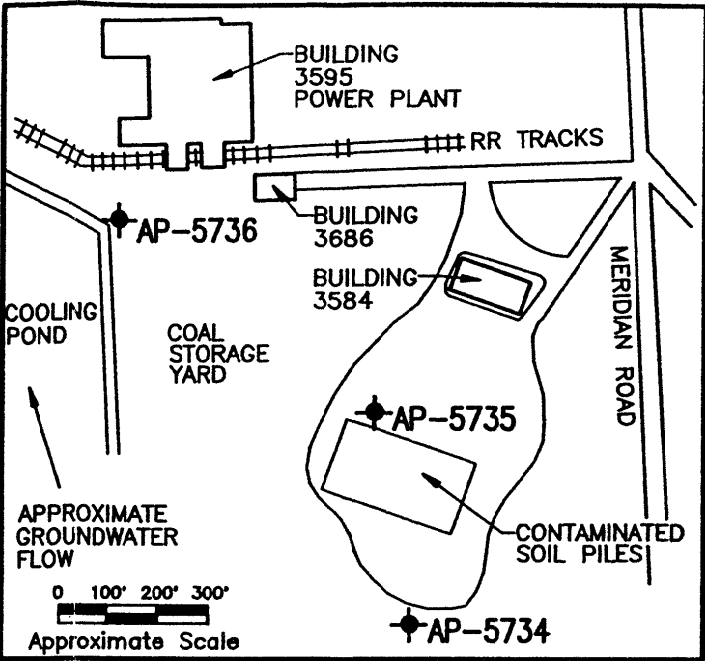
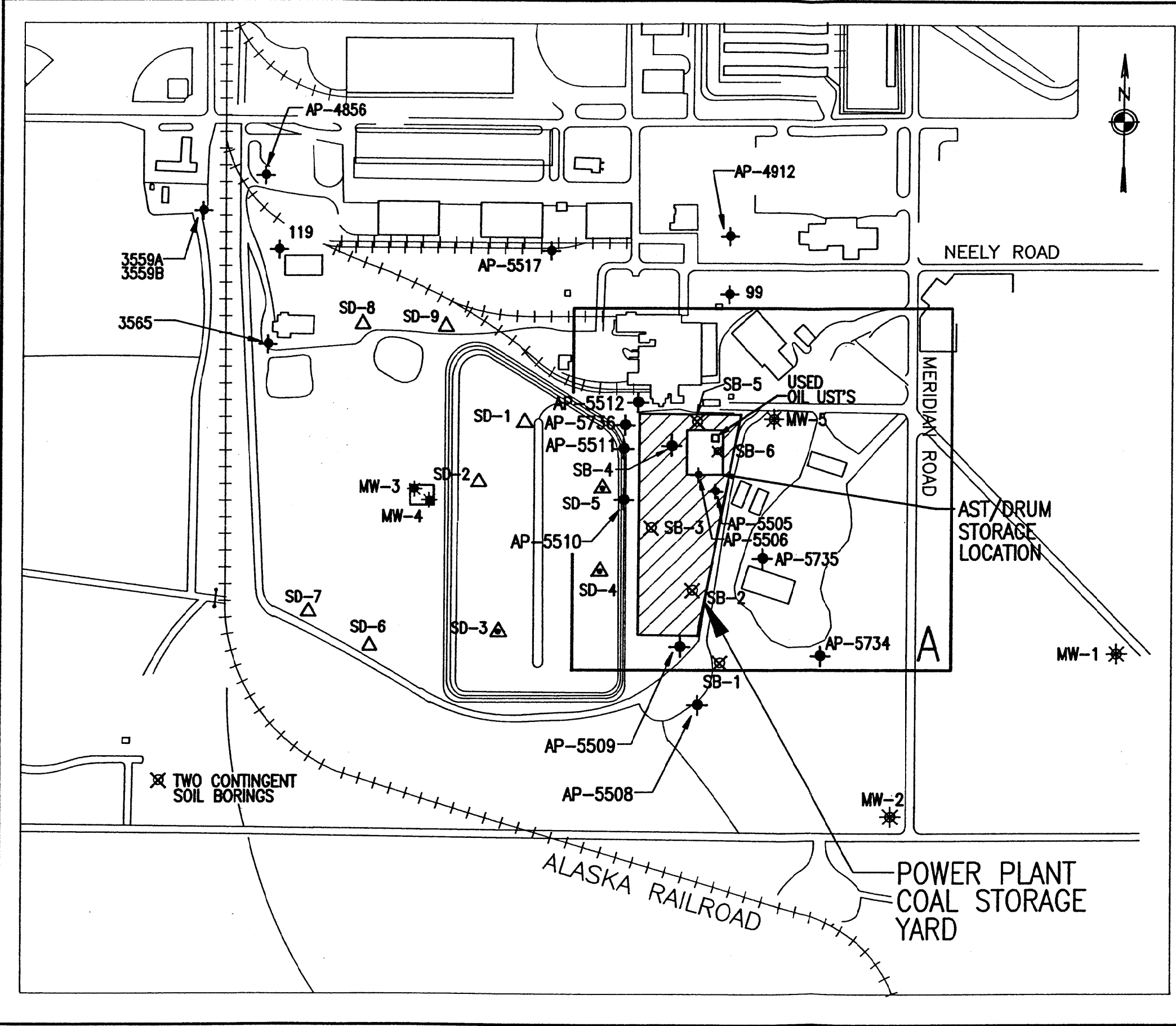
- Marshy area
 Surface water / sediment sample
 0 500 1000
 Scale in Feet

Reference: E & E 1991

DEPARTMENT OF THE ARMYALASKA DISTRICT, CORPS OF ENGINEERS
ANCHORAGE, ALASKA

DESIGNED:	FAIRBANKS, ALASKA		
DRAWN: EGM	FORT WAINWRIGHT, OPERABLE UNIT 4		
TRACED:	LANDFILL PROPOSED		
CHECKED: ID	SURFACE WATER/SEDIMENT		
SUBMITTED:	LOCATION MAP		
CHIEF	RECOMMENDED:		DATE:
			04-20-93
CHIEF	SECTION	CHIEF, ENGINEERING DIVISION	
DRAWING NUMBER		SCALE:	
KQF2-4.DWG		PLATE NUMBER	
		FIGURE 2-4	

C:\CORP\KQ200\KQF2-4.DWG\APR.20,1993



LEGEND

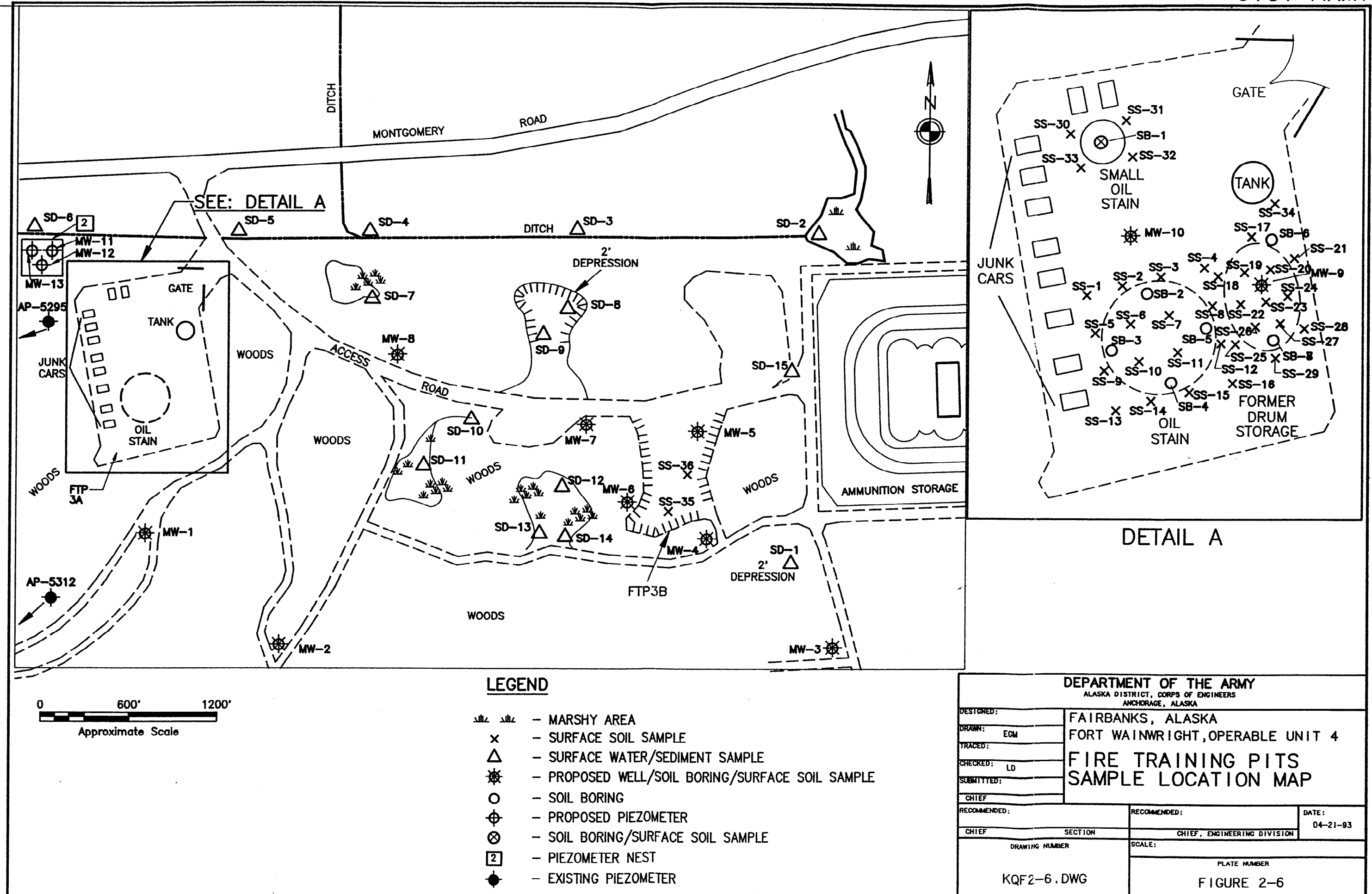
- ◆ - EXISTING WELL
- - PIEZOMETER NEST
- △ - SURFACE WATER/SEDIMENT SAMPLE
- ▲ - SEDIMENT SAMPLE
- ⊗ - SOIL BORING/SURFACE SOIL SAMPLE
- ✱ - PROPOSED WELL/SOIL BORING/SURFACE SOIL SAMPLE
- +++++ - RAILROAD

INSET "A"

0 500' 1000'

Approximate Scale

DEPARTMENT OF THE ARMY			
ALASKA DISTRICT, CORPS OF ENGINEERS			
ANCHORAGE, ALASKA			
DESIGNED:	FAIRBANKS, ALASKA		
DRAWN: EGM	FORT WAINWRIGHT, OPERABLE UNIT 4		
TRACED:	POWER PLANT COAL		
CHECKED: LD	STORAGE YARD		
SUBMITTED:	SAMPLE LOCATION MAP		
CHIEF	RECOMMENDED:		
CHIEF	SECTION	CHIEF, ENGINEERING DIVISION	DATE: 03-03-93
DRAWING NUMBER		SCALE:	
KPF2-5.DWG		PLATE NUMBER	
		FIGURE 2-5	



3. GEOPHYSICAL INVESTIGATION

A terrain conductivity investigation will be conducted to identify buried metal objects and permafrost before and concomitant with the subsurface soil investigation. Also, a ground penetrating radar (GPR) survey will be conducted to identify pipelines or other man-made interferences beneath drilling locations. A combination of a frequency- and/or time-dependent electromagnetic (EM) survey and a GPR survey will also be used to identify and characterize any potential thaw bulbs and/or talik zones existing in the permafrost, particularly in the landfill area.

The geophysical investigations described in this section are designed, in part, to assist in the characterization of potential migratory pathways within the source areas where contamination is identified. Other studies, particularly through United States Army Cold Regions Research and Engineering Laboratory (CRREL), may be conducted during the same period of time as the RI for OU-4 and with similar data collection objectives. The field investigations for OU-4 will be coordinated, to the extent possible, with these ongoing investigations in an effort to gain additional data for the objectives of OU-4, and to provide useful data for the objectives defined for these other investigations. This element of coordination will be accomplished within the framework of the defined RI/FS schedule and FFA milestones.

3.1 PRE-DRILLING LOCATION SURVEY

The Directorate of Public Works (DPW) will be responsible for locating all utilities including pipelines and tanks prior to drilling operations. After DPW has identified all utilities, geophysical surveys will be conducted prior to drilling. The surveys are not certain to detect all drilling hazards and are only used as a precaution against drilling into an uncharted subsurface hazard. The surveys are not intended to replace the service provided by DPW for location of all utilities.

3.1.1 Electromagnetic Conductivity Survey

The EM geophysical technique measures the apparent terrain conductivity of a portion of the subsurface. The EM instrument transmitter coil (dipole) is energized by an alternating current that generates a primary magnetic field. This field induces a secondary magnetic field in the subsurface that is sensed by the receiver coil (dipole). The receiver coil measures the ratio of the primary and secondary magnetic fields and yields a reading of this ratio in millimhos per meter (mmhos/meter). The ratio of the field strengths is proportional to the intercoil spacing and frequency of the instrument as well as to the permeability and conductivity of the surrounding area. When intercoil spacing and frequency are fixed as a function of the instrument design or manually (intercoil spacing only), the field ratio represents a direct indication of apparent terrain conductivity.

Apparent terrain conductivity is influenced by a number of factors including moisture content of the subsurface, presence and concentration of dissolved chemical species, and characteristics of the solid matrix (e.g., porosity, clay content, mineral composition, compaction, etc.). Individual EM readings reflect the combined influence of all of these factors averaged over the effective exploration depth of the instrument which is determined by the distance between the transmitting and receiving coils at a given frequency. Assuming that the natural characteristics of the solid matrix remain constant, EM readings can be considered indicative of varying concentrations of sorbed soil matrix contaminant species or dissolved contaminant species in the groundwater.

3.1.1.1 Instrumentation

The EM survey will be conducted using an EM-31 or EM-34-3 Terrain Conductivity Meter manufactured by Geonics, Ltd., or equivalent. The EM-31 has an effective exploration depth of 3 to 6 meters (10 to 20 feet) depending on whether the coils are oriented perpendicular to the ground surface (vertical coplanar mode) or parallel (horizontal coplanar mode). The intercoil spacing is fixed in this instrument. The EM-34-3 has an effective exploration depth of 7.5 to 60 meters depending on horizontal or vertical dipole orientation and intercoil spacing. At each survey station, four readings will be recorded: one parallel and one perpendicular to the grid line for both the horizontal and vertical coplanar modes.

The EM-31 and EM-34-3 have been effectively used in identifying permafrost in the subsurface at Fort Wainwright. Previous studies have shown that permafrost characteristically

exhibits a conductivity of less than 1 mmhos/meter, while areas not underlain by permafrost exhibit a significantly higher conductivity value (E & E 1991; Woodward-Clyde 1988).

3.1.1.2 Methodology

The geophysical survey will be performed in accordance with the standard operating procedure (SOP) for conducting electromagnetic conductivity surveys at hazardous waste sites to be supplied by the contractor prior to the field investigation. The site-specific geophysical procedures are discussed below.

Survey grids will be constructed using a measuring tape and compass, and will be identified with a numbering system that incorporates the identification number of the specific soil boring or monitoring well. The grids are estimated to cover an area approximately 60 feet by 60 feet, centered on the proposed drilling location. This distance may change in the field, based on topographical constraints. The survey grids will consist of station nodes with 15-foot spacing intervals. Wherever possible, the x and y axes of the survey grids will be oriented east-west and north-south, respectively. A grid with approximately 20 to 25 nodes will be set-up at each survey location. The EM-31 instrument will be positioned so that the instrument is approximately 1 meter above the ground surface. The survey grid area will be systematically walked and instrument readings will be recorded along a transect line and at discrete nodes. These readings will be recorded on a geophysical survey data sheet and/or stored in an electronic data logger.

The EM survey will be conducted using both continuous profiling between grid points and discrete sounding at the grid points to characterize lateral and vertical variations in ground conductivity. Approximately four readings will be taken at each node (for a total of 80 to 100 readings per grid), representing the vertical and horizontal dipole alignment along the X-axis and 90° to these measurements along the Y-axis of the survey grid. Differences in the readings will indicate that the ground is not homogeneous and may represent subsurface features, such as underground piping or permafrost. Additional readings will be conducted if subsurface conditions warrant.

Prior to performing a geophysical survey, a background area transect line will be established and measurements will be performed at 10-foot intervals. The background survey area should be lithologically similar and will be selected such that the geology, slope, vegetative cover, etc., will be comparable to the main survey/drilling area. The background survey will be conducted in an area presumed to be free of subsurface anomalies to ensure that the EM-31 unit is functioning

properly. Additionally, an interference survey will be conducted near any existing power lines to establish what influence the power lines have on the EM readings. The interference survey will be conducted along transect lines at 10-foot intervals parallel and perpendicular to the power lines.

As the area of interest is systematically walked, a determination of the extent of subsurface conductivity differences can be made. After completing the geophysical survey, areas of significant conductivity differences can be examined in greater detail to help establish areal extent of subsurface anomalies.

EM survey readings may be stored electronically using a data logger for later retrieval and/or interpretation using various modeling and/or contouring techniques. At a minimum, EM survey results will be recorded on standard geophysical logging sheets for later data use.

3.1.2 Ground Penetrating Radar Survey

The GPR survey will be conducted using a GPR instrument that transmits high frequency radio waves into the subsurface via a small antenna that is moved slowly across the ground surface. The EM signal is reflected back to a receiving antenna from the interfacial surfaces between materials that exhibit different electrical properties. The variations in the return signal are amplified, filtered, processed, and recorded continuously to produce a continuous diagrammatic cross-sectional "profile" of shallow subsurface conditions. The interfacial boundaries that generate reflections of the EM signal commonly are associated with natural geologic and hydro-geologic features such as bedding, cavities, fractures, intrusions, variations in type and degree of cementation, and variation in moisture and clay content. The interface between subsurface soils and buried man-made objects such as pipelines can produce a signal reflection. Furthermore, given that the presence of adsorbed or dissolved contaminant species also can affect the electrical properties of lithologic units, GPR surveys can provide an indication of the presence and extent of subsurface contamination, especially if computer enhancement of signal reflection profiles is employed.

The exploration depth of GPR instruments is highly site-specific and highly dependent on the specific properties of the subsurface materials. In particular, the presence of electrically conductive materials such as clays in the shallow subsurface will restrict the exploration depth greatly. However, the continuous profiles provided by the GPR survey offers the potential of

obtaining substantially more detail than is possible from many of the alternative geophysical survey techniques.

A GPR survey was conducted by the United States Army Cold Regions Research and Engineering Laboratory (CRREL) at Fort Wainwright in March and April 1992. A Geophysical Survey System, Inc. (GSSI) GPR system was employed using 100 Mhz and 500 Mhz antennas. The 500 Mhz antenna provided the best resolution and penetration for the conditions found at the Fort. Fairly accurate determinations of subsurface features beneath the survey areas were achieved. Distinctions between permafrost, non-permafrost, and seasonal frost zones were identified, and structural stratification of soils and the water table also were identified. Subsurface utilities and obstructions were located for potential drilling sites (ADCOE 1992).

3.1.2.1 Instrumentation

The GPR survey will be conducted using GPR systems manufactured by the Oyo Corporation of Houston, Texas, or by GSSI of Hudson, New Hampshire. Most GPR systems are similar and consist of antennas, a control unit, and graphical or digital recorders. It may be necessary to have two different antennas of differing frequency available, depending upon site subsurface conditions.

3.1.2.2 Methodology

The geophysical survey will be performed in accordance with the SOP for conducting ground penetrating radar surveys at hazardous waste sites to be provided by the contractor prior to the field investigation. The site-specific procedures are discussed below.

The GPR instrument will be pulled by hand over the area of interest, while the electronic signal of the instrument is recorded graphically and/or digitally. The GPR surveys will be conducted using a minimum of three survey lines for each location suspected of containing subsurface anomalies. At least one of the survey lines will be perpendicular to the other survey lines.

Prior to performing the GPR survey, a background area will be selected with comparable geology, slope vegetation cover, permafrost, etc., to the area of interest. Additionally, a wide-angle reflection and refraction (WARR) survey may be conducted to determine the electrical properties of the subsurface to optimize the wave values of the GPR to make accurate estimates of depth.

The GPR results will be recorded graphically on strip chart paper for real time analysis in the field. The results may also be stored electronically for digital processing to enhance subsurface features using modeling software.

3.2 LANDFILL SURVEY

An attempt will be made to define and characterize the subsurface extent of the landfill and any associated thaw bulbs and/or permafrost which may underlie the landfill and affect transport of contaminants. A proposed survey utilizing the EM-34-3 and a GPR will be conducted in the landfill characterization. Alternately, and or, jointly the time domain electromagnetic (TDEM) survey technique utilizing an EM-47 or equivalent instrument may be employed to provide a depth-dependent profile of the landfill.

Data obtained from the geophysical investigation will be incorporated with available data obtained from CRREL studies which may be conducted at or adjacent to the landfill area. All geophysical efforts in the landfill area will focus on characterizing the extent of permafrost that may or may not exist beneath the overburden and refuse of the landfill, or characterizing other subsurface conditions that might influence groundwater movement. The instruments identified for the landfill geophysical investigation represent the best known available technologies for providing subsurface data beneath the landfill, given the conditions that likely exist (i.e., refuse and potential permafrost). Utilization of the instruments and reduction of the data may be modified, if necessary, in an attempt to fully characterize subsurface conditions. Interpretation of the geophysical data will include a discussion of techniques attempted, as well as techniques applied.

3.2.1 Instrumentation

The EM survey will be conducted using an EM-34-3 Terrain Conductivity Meter manufactured by Geonics, Ltd., or equivalent. The EM-34-3 has an effective exploration depth of 7.5 to 60 meters depending on horizontal or vertical dipole orientation and intercoil spacing.

The GPR survey will be conducted using GPR systems manufactured by the Oyo Corporation of Houston, Texas, or by GSSI of Hudson, New Hampshire. Most GPR systems are similar and consist of antennas, a control unit, and graphical or digital recorders. It may be necessary to have two different antennas of differing frequency available, depending upon site subsurface conditions.

The TDEM survey will be accomplished with an instrument such as an EM-47 transient electromagnetic survey system manufactured by Geonics, Ltd., or equivalent capable of differentiating between different layers with depth in the subsurface.

3.2.2 Methodology

EM-34-3 Survey. The EM survey will be performed in accordance with the SOP for conducting electromagnetic conductivity surveys at hazardous waste sites to be supplied by the contractor prior to the field investigation. The landfill-specific EM procedures are discussed below.

A survey grid will be constructed using a measuring tape and compass, and will be identified with a north-south coordinate numbering system. The grids are estimated to cover an area approximately 500 feet by 1,000 feet. This distance may change in the field, based on topographical constraints and actual landfill dimensions. The survey grids will consist of station nodes with a minimum 25-foot spacing intervals. The x and y axes of the survey grid will be oriented east-west and north-south, respectively. The EM-34-3 instrument will be positioned so that the instrument is above the respective grid node location. The survey grid area will be systematically walked and instrument readings will be recorded at discrete nodes. These readings will be recorded on a geophysical survey data sheet and/or stored in an electronic data logger.

The EM survey will be conducted using discrete sounding at the grid points to characterize lateral and vertical variations in ground conductivity. Approximately four readings will be taken at each node, representing the vertical and horizontal dipole alignment along the X-axis and 90° to these measurements along the Y-axis of the survey grid. Differences in the readings will indicate that the ground is not homogeneous and may represent subsurface features, such as permafrost. Additional readings will be conducted if subsurface conditions warrant.

Prior to performing the geophysical survey, a background area transect line will be established and measurements will be performed at minimum 25-foot intervals. The background survey area should be lithologically similar and will be selected such that the geology, slope, vegetative cover, etc., will be comparable to the landfill area. The background survey will be conducted in an area presumed to be free of subsurface anomalies to ensure that the EM-34-3 unit is functioning properly.

As the area of interest is systematically walked, a determination of the extent of subsurface conductivity differences can be made. After completing the EM survey, areas of significant

conductivity differences can be examined in greater detail to help establish areal extent of subsurface anomalies.

EM survey readings may be stored electronically using a data logger for later retrieval and/or interpretation using various modeling and/or contouring techniques. At a minimum EM survey results will be recorded on standard geophysical logging sheets for later data use.

GPR Survey. The GPR survey will be performed in accordance with the SOP for conducting ground penetrating radar surveys at hazardous waste sites to be provided by the contractor prior to the field investigation. The site-specific procedures are discussed below.

The GPR instrument will be pulled by hand over the landfill, while the electronic signal of the instrument is recorded graphically and/or digitally. The GPR survey will be conducted using a minimum of five survey lines transecting the landfill. At least two of the survey lines will be perpendicular to the other survey lines.

Prior to performing the GPR survey, a background area will be selected with comparable geology, slope vegetation cover, permafrost, etc., to the landfill. Additionally, a WARR survey may be conducted to determine the electrical properties of the subsurface to optimize the wave values of the GPR to make accurate estimates of depth.

The GPR results will be recorded graphically on strip chart paper for real time analysis in the field. The results may also be stored electronically for digital processing to enhance subsurface features using modeling software.

TDEM Survey. The TDEM survey will be performed in accordance with the SOP for conducting electromagnetic conductivity surveys at hazardous waste sites to be supplied by the contractor prior to the field investigation. The landfill specific TDEM procedures are discussed below.

The value of resistivity measured at the surface is a measure of all the resistivities of subsurface bodies within the area of influence of the TDEM instrument. The value measured at the surface is defined as the apparent conductivity or inversely the apparent resistivity. By the use of computer driven mathematical algorithms the apparent conductivity is transformed into true conductivity and thicknesses of the individual subsurface layers encountered below the instrument. The accuracy and uniqueness of the transform depends on the geoelectric section, the TDEM method, and the number of data points utilized in the survey (Geonics 1991).

Prior to the TDEM survey, a background area will be selected with comparable geology, permafrost, etc. to the landfill.

4. MONITORING WELL CONSTRUCTION AND INSTALLATION

This section describes the requirements and methods for drilling and installing monitoring wells, and piezometers at the OU-4 source areas. Prior to entering the field to drill and install monitoring wells, drilling specifications will be prepared and necessary permits will be obtained by the drilling contractor. Monitoring well construction will comply with State of Alaska and federal regulatory requirements and recommendations regarding access, drilling, groundwater extraction, and disposal of derived wastes. The drilling contractor will use only personnel who are OSHA-certified to work on hazardous waste sites and will provide all the appropriate equipment for well installation.

Hollow-Stem Auger. Soil borings to a maximum depth of 60 feet bgs will be drilled using hollow-stem augers as appropriate for well installation and soil sampling. Hollow-stem auger drilling involves advancing a bit attached to an appropriate diameter auger without use of drilling fluid. When the desired depth is achieved, the well pipe is installed through the hollow center of the auger flights. To access swampy areas and rough terrain, a track-mounted drilling rig will be used.

Air Rotary. Deep monitoring wells to be installed below the permafrost (including the 200-foot wells) will be constructed using air rotary drilling techniques. Petroleum-based products will not be used for lubrication of the downhole tools on equipment. The air rotary drilling system will have appropriate in-line air filters capable of removing any compressor soils that may be generated during the drilling process.

During the air rotary drilling a 12-inch conductor casing will be set 5 feet at a minimum into any confining layer (permafrost) encountered and then pressure grouted to seal the casing. After this seal has effectively set for a minimum of 24 hours, drilling into the underlying aquifers will continue. An 8-inch diameter steel working casing will then be advanced within the conductor

casing so that no more than 1-foot of open borehole extends beyond the bottom of the working casing at any time. The working casing assembly will include a steel drive shoe.

Once the borehole has been drilled to its total depth and sampled, a zone will be selected for screening. The screen and casing will be installed, according to techniques described in Section 4.1.

The monitoring wells will have a screened interval across the water table, and at least six piezometers will be screened below the water table. Existing wells and/or piezometers may be incorporated into a piezometer nest. Well depths will vary depending on the depth to the water table and the presence of localized perched water-bearing zones and permafrost. The water table is expected to be encountered at depths of 15 to 20 feet at the landfill, CSY, and FTPs.

An estimated 23 monitoring wells are anticipated for plume delineation, or piezometers at the landfill, 13 monitoring wells are anticipated for the CSY, and 13 monitoring wells at the FTPs.

Each monitoring well will be constructed with a 15-foot screened interval. At least 5 feet of screen will remain above the saturated zone to allow for seasonal fluctuations in the water table and permit the entrance of lighter-than-water contaminants for sampling. Piezometers are anticipated to consist of 2-inch wells with a 2-foot screened interval.

Designated wells may be installed beneath seasonal frost layers to monitor the underlying groundwater. The soil borings for these wells will be cased as soon as frozen material is encountered in preparation for sealing in the case of flowing artesian wells. If permafrost is encountered during the drilling of the other monitoring wells, the procedures outlined in Section 5.2 will be followed.

4.1 STANDARD MONITORING WELL CONSTRUCTION

Wells and piezometers will be constructed of 2-inch I.D., Schedule 40 or 80 National Sanitation Foundation (NSF)-approved polyvinyl chloride (PVC) casing with flush-threaded joints. Four-inch Schedule 80 casing will be used if the well is more than 50 feet deep, if permafrost conditions exist, or if contamination conditions warrant, the installation of remedial wells (FTP). The wells will be screened using 2-inch or 4-inch Johnson Environmental Vee-Wire stainless steel 0.01-inch slot size continuous wound, pre-pack environmental screen or equivalent. A 1- to 3-foot long, 2-inch or 4-inch diameter, Schedule 40 or 80, matching thread, NSF-approved sump will be attached to the base of the well screen. All PVC joints will be of matching flush-threaded

design with viton o-rings and will be screened together without the use of glues, epoxies, or petroleum-based lubricants. All materials will be cleaned and placed in polyethylene bags at the factory; the bags will remain sealed until the time of installation.

The annular space of each soil boring will have a minimum radius of 2 inches from the soil to the well casing.

A prepacked screen will be used for all monitoring wells. The prepacked screen must be a stainless steel, double-walled environmental screen (0.008 or 0.010-inch slot) with a 10-20 mesh, 20-40 mesh, or 40-60 mesh sand pack, depending upon aquifer characteristics. Prepacked screens will be used since the formation materials likely are unstable and tend to slough in the soil boring.

A 2-foot thick Pure Gold or equivalent bentonite pellet seal will be installed directly above the sandpack. A time release bentonite pellet or bentonite doughnut may be utilized if heaving or sloughing conditions are encountered in the deeper monitoring wells. A calculated volume of clean municipal water will be added and a time period (minimum 1 hour) allotted for maximum hydration. The remaining annulus will be filled with Pure Gold or equivalent high solids bentonite grout. The bentonite grout will consist of an admixture of powdered bentonite with the recommended volume of water to achieve an optimal seal. The grout must contain at least 30 percent solids by weight and have a density of 9.4 pounds/gallon or greater. Prior to any development activities, the annular seal will be allowed a minimum of 24 hours curing time. All admixtures will be in accordance with appropriate EPA and state regulations. Grout must be emplaced using a tremie pipe from the bottom of the annular space upwards to the surface.

The proposed standard well completion is presented in Figure 4-1. The proposed well completion for monitoring well completion below a confining layer (i.e., permafrost) and FTP remedial wells is presented in Figure 4-2.

4.1.1. Piezometers

Piezometers will be constructed of 2-inch I.D. Schedule 40 or 80 NSF-approved PVC casing with flush-threaded joints. Schedule 80 casing will be used if the well is more than 50 feet deep or if permafrost conditions exist. The piezometer will be screened using 2-inch Johnson Environmental or equivalent Vee-Wire stainless steel 0.01-inch slot size continuous wound, 2-foot environmental screen or equivalent. A 1-foot long, 2-inch diameter, Schedule 40 or 80 matching thread, NSF-approved sump will be attached to the base of the well screen.

4.1.2 Monitoring Wells

Monitoring wells will be constructed of 2-inch I.D. Schedule 40 or 80 NSF-approved PVC casing with flush-threaded joints. Schedule 80 casing will be used if well depth is more than 50 feet or permafrost conditions exist. The wells will be screened using 2-inch Johnson Environmental Vee-Wire stainless steel 0.01-inch slot size continuous wound, 15-foot environmental screen. A 1- to 3-foot long, 2-inch diameter, Schedule 40 to 80 matching tread, NSF-approved sump will be attached to the base of the wellscreen.

Deep Monitoring Wells and FTP Remedial Wells. The deep monitoring wells and FTP remedial wells will be constructed with a 4-inch I.D., Schedule 40 or 80, flush-threaded PVC casing with 15-foot length of 0.010-inch slot size continuous wound Johnson Vee-Wire stainless steel screen or equivalent. A 1- to 3-foot long PVC sump will be installed below the well screen. Centralizers will be installed on the sump, on the well casing 10 feet above the top of the screen, and at intervals of every 10 feet to ground surface.

4.2 WELL DEVELOPMENT, COMPLETION, AND PROTECTION

Well development will be accomplished by surging, pumping, bailing, and/or swabbing to achieve maximum hydraulic connection. The installed wells will be developed until the development water is sediment free and/or until it is developed to the satisfaction of the field geologist based on consecutive pH, temperature, and conductivity readings.

Well development will continue until a minimum of three to five well volumes have been purged and the following parameters have stabilized within the ranges specified:

pH	+/- 1 pH unit
Temperature	+/- 0.5°C
Conductivity	+/- 10%
Oxidation/Reduction	+/- 10%

Turbidity will be measured with a nephelometer to record the change in relative turbidity during the development process.

Monitoring wells installed which exhibit significant turbidity based on nephelometer readings and which are likely to be contaminated will be selected for dedicated pump installation. Final

development parameter readings along with PID/FID readings will be reviewed by the field geologist for potential dedicated pump installation. If PID/FID readings indicate the presence of contaminants or the monitoring well is located within an area of known groundwater contamination, and turbidity values exceed 50 NTUs, then a dedicated bladder pump will be installed for sampling.

Should floating product be encountered or PID/FID readings indicate the presence of contaminants, all water will be handled as discussed in Section 5.9. A mechanical surging method will be used to develop wells with floating product should it be encountered to minimize the generation of liquid waste. The method involves forcing water into and out of the well screen by moving a surge block up and down in the riser casing.

Development of the well will begin near the top of the screen and progress downward to prevent the development tool from becoming sandlocked. Fine-grained material will be removed from the well with a bailer periodically during the development. All development waters generated will be drummed in DOT 17E/17H drums and labeled appropriately with the monitoring well number.

In accordance with ADCOE guidelines, a 1-liter sample of water will be collected in a clear glass jar at the completion of development of each well. These samples will be labeled and photographed, using 35 mm color slide film. The photograph will provide a back-lit closeup view that shows the clarity of the water. All slides will be submitted as part of the well log record.

A surface 5-foot steel protective casing will be fitted over the well casing and grouted into place. A minimum of 3 feet of the casing will be set into the ground. A crushed gravel pad, minimum 3-foot square, thick, sloped away from the well will be constructed around the well casing at the final ground level. Three steel posts will be spaced equally around the well and embedded in the gravel pad to serve as guards. The steel protective casing will be painted with permanent high visibility paint. A fiberglass, wood, or similar pole will be attached to the well casing to identify its location during periods of heavy snowfall. An alternate completion of monitoring wells installed at ground surface is to use an at-grade Westinghouse or similar well vault. The well vault should be designed for monitoring well use, be water resistant, and capable of withstanding heavy traffic loads. The minimum vault size will be 2 feet by 2 feet. The vault may be set in reinforced cement depending upon site conditions to be determined during the field investigation.

Final well completion will include an expandable frost-plug system which when installed just above the well screen prevents groundwater from rising up into the riser pipe and freezing. This system may help monitoring well maintenance over the long period of time the wells are expected to be utilized.

All monitoring wells will be equipped with a locking aluminum custody seal which will be used to prevent tampering of the monitoring wells. The custody seals will be labeled with an alphanumeric system code which will be monitored and changed during each sampling event. The system code will include the monitoring well number and the date of the last sampling event (i.e., MW-2-93-04-28). Prior to breaking the custody seal for each sampling event, the integrity of the seal and code number will be recorded in the field logbook.

4.3 WELL AND MONUMENT LOCATION SURVEY

Coordinates and elevations for each monitoring well will be established by a licensed State of Alaska surveyor. Horizontal coordinates will also be established for each soil boring not completed as a monitoring well. The coordinates will be to the closest 1.0 foot and referenced to the State Plane Coordinate System as well as the foot-wide grid system. A survey marker will be set permanently into the ground pad surrounding each well. Elevations to the closest 0.01 foot will be provided for the survey marker and the top of the casing at each well. The measurement for the casing elevation will be taken from a reference point on the north lip of the inner well casing (uncapped). These elevations will be referenced to the National Geodetic Vertical Datum, if readily available, otherwise, the existing local vertical datum will be used. The location, identification, coordinates, and elevations of the wells will be plotted on the existing topographic base map prepared for the OU-4 site. The designated number of the well, the X and Y coordinate, and all required elevations will be recorded and tabulated.

The monitoring wells will be resurveyed on an average of every 2 years to determine if elevations of the wells have been altered by freeze-thaw cycles or other events. In the event that a monitoring well is observed to have been disturbed, resurveying of the well may be completed to ensure accurate monitoring results.

4.4 AQUIFER TESTING

Following installation of the monitoring wells, the contractor will conduct a hydrogeological evaluation consisting of falling and rising head slug tests or a pumping test at monitoring wells

representative of the underlying aquifer units. The resulting data will be used to estimate hydraulic characteristics, including conductivity and transmissivity of the aquifer. Because the hydraulic parameters of some areas are quite high, only estimates of the aquifer may be possible (see Section 4 of the Management Plan). Monitoring wells to be tested will be selected in the field during the RI on the basis of formation materials and groundwater conditions that are most representative of conditions at the source area. The tests described below may be modified prior to field work to implement other techniques (i.e., thermistors). The technique used must provide equivalent data (i.e., transmissivity, drawdown, flow direction, flow gradient, well yield).

4.4.1 Water Level Measurements

Water level measurements will be performed daily during the field investigation for the RI. Existing monitoring wells identified for sampling and new monitoring wells, as they are installed, for OU-4 will be measured. Daily monitoring will provide data on local groundwater trends and potential fluctuations in flow direction and/or gradient over the period of time in which the RI field investigation is conducted. Static water levels will be measured to the nearest 0.01 foot. If encountered, floating-product will be measured using an oil-water interface probe having an accuracy of 1/32-inch to 1/8-inch.

Long term monitoring will be performed on selected wells at each source area to establish seasonal fluctuations and the effect these fluctuations have on the groundwater flow direction and gradient. The monitoring program will be initiated by ADCOE with appropriate downhole equipment (e.g., transducers) and data recording instrumentation. The recommended wells for long term monitoring are provided in the preliminary list below.

Well	Completion Depth (feet bgs)
<u>Landfill Area</u>	
W-LF-1	40
W-LF-2	30
MW-8	15
MW-9	200
MW-4	45
<u>Coal Storage Yard</u>	
MW-1	30
MW-3	30
MW-4	60
MW-5	30
<u>Fire Training Pits</u>	
MW-14	15
MW-15	60
MW-16	30

These wells have been selected on the basis of optimizing information on the groundwater flow direction and gradient as it is understood in each source area. Additional or alternate wells may be selected during the RI as preliminary water level data are accumulated.

4.4.2 Slug Tests

Slug tests will be performed in accordance with SOPs for conducting slug tests at hazardous waste sites to be provided by the contractor prior to the field investigation.

A slug test consists of instantaneously injecting or withdrawing a known volume of water and measuring the fluctuation of the groundwater level as it returns to static conditions. Alternately, an air compressor may be used to depress or raise the water level pneumatically. The return of the groundwater level can be related by means of mathematical formulas to aquifer parameters such as hydraulic conductivity.

The primary advantages of using slug tests to estimate hydraulic aquifer parameters include:

- Estimates can be made in-situ, as opposed to laboratory bench tests;
- Pumping and disposing of potentially contaminated water is not necessary;

- Tests can be performed at relatively low costs;
- Observation wells are not required-small diameter wells can be used; and
- Hydraulic parameters of discrete portions of an aquifer can be analyzed and tight formations can be effectively analyzed.

Disadvantages of slug tests include:

- Only the hydraulic parameters of the area immediately surrounding the well are estimated, which may not be representative of the areal extent of the aquifer. Additionally, drilling methodology, well design, and well development may limit the testing and provide erroneous results;
- The storage coefficient, S , usually cannot be determined by this method; and,
- There are no specific slug sizes provided for a given monitoring well configuration or aquifer type.

Slug tests will be performed on a minimum of four wells, with at least two wells completed in the same aquifer matrix to provide a comparison of hydraulic parameters for the aquifer matrix. The testing will be performed using a stainless steel or sandfilled PVC slug of known volume, an electronic data logger and transducer or similar groundwater level recording device, and a portable computer to accept downloaded slug test data and provide slug test evaluation, if applicable.

Multiple slug tests will be performed on each well tested to provide accurate estimates of the hydraulic parameters of the aquifer and ensure that representative values are achieved. Slug tests will be performed at the nested well locations.

4.4.3 Pumping Test

The pumping test will be performed in accordance with an SOP for conducting pumping tests at hazardous waste sites to be provided by the contractor prior to the field investigation. The test will be used to evaluate the hydraulic parameters of the aquifer and/or the well. A simple pumping test involves a system with one pumping well and two or more observations wells in which to measure drawdown response of the groundwater within the pumped aquifer.

The drawdown observed in the pumping well and observation wells can be related by mathematical means to general aquifer parameters of hydraulic conductivity, transmissivity, and storativity coefficients.

Primary advantages of performing a pumping test include:

- Aquifer characteristics can be evaluated over a larger area than that of a slug test;
- Aquifer long-term response and yield can be estimated; and
- Degree of contaminant migration and transient concentration changes can be evaluated.

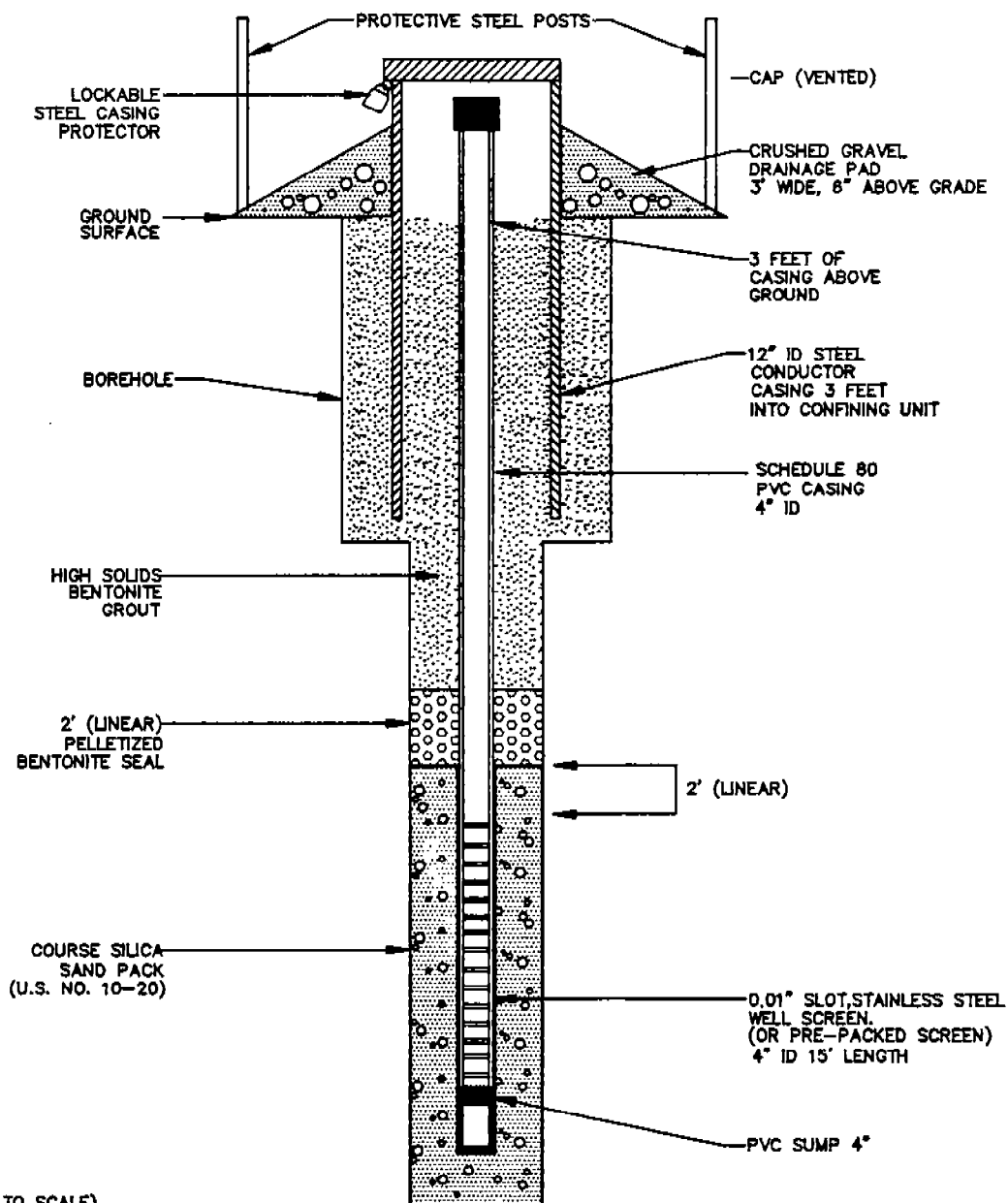
Disadvantages of a pumping test include:

- Pumping tests are usually more costly than slug tests;
- Purge waters must be treated or contained in some particular manner;
- Generally, longer time periods are required to obtain the required data; and
- The test is only effective in aquifer units that yield significant quantities of water.

Continuous discharge pumping tests will be performed on a minimum of one well at the landfill source area, possibly at the Ski Hill snow making well. A minimum pumping test of 24 hours will be used to ensure that the aquifer has been significantly stressed to determine accurate hydraulic parameters of the aquifer. The pumping test will be performed using a 1/4 to 1 horsepower submersible pump installed in a 4-inch or larger monitoring well. The pump will be capable of pumping a minimum of 50 gpm for the entire pumping test. Drawdown of the groundwater elevation will be monitored in the pumping well and in observation wells for the full extent of the pumping test. Recovery groundwater elevators will also be measured in the wells at the termination of the pumping to provide additional data. An electronic data logger and transducer will be used to monitor groundwater elevation changes during the test. Hand-held electronic water level meters may also be used to measure groundwater elevations. A portable computer will be utilized for downloading data and evaluating and analyzing it, if applicable. Discharge water will be measured or estimated with an appropriate flow device. Discharge

waters will be containerized in Baker tanks or similar holding tanks, or discharged to surface or sewer, if analyses indicate that the groundwater is free of contaminants.

A pump test will be performed at a well location in the landfill source area. The tests will be modified as appropriate, particularly if well performance is less than expected, in which case a slug test will be performed instead. Well yields have been known to be high in some areas at Fort Wainwright, in which case pumping rates may not be enough to initiate a drawdown in monitored wells. Under these conditions, an estimate of hydraulic parameters will be made. Pumping test data from Operable Unit 3, particularly the Railcar Off-Loading Facility, will be used to estimate parameters for the CSY and the FTPs.



(NOT TO SCALE)

DEPARTMENT OF THE ARMY ALASKA DISTRICT, CORPS OF ENGINEERS ANCHORAGE, ALASKA			
DESIGNED:		FAIRBANKS, ALASKA FORT WAINWRIGHT, OPERABLE UNIT 4 PROPOSED DEEP MONITORING WELL CONSTRUCTION	
DRAWN: EGM			
TRACED:			
CHECKED: LD			
SUBMITTED:			
CHIEF			
RECOMMENDED:		RECOMMENDED:	DATE:
CHIEF		CHIEF, ENGINEERING DIVISION	11-13-92
DRAWING NUMBER		SCALE:	
KPF4-2.DWG		PLATE NUMBER	
		FIGURE 4-2	

c:\CORP\KPS901\KPF4-2

5. SAMPLING METHODS

Media-specific sampling procedures for the OU-4 RI are described below. The procedures are consistent with methodologies described in the Quality Assurance Project Plan (QAPjP) for OU-4 as well as those described in the EPA's Compendium of Superfund Field Operations Methods (EPA 1987).

5.1 SURFACE SOIL

Surface soil samples will be collected as grab samples from the top 0- to 8-inches of soil. A dedicated or decontaminated stainless steel spoon or trowel will be used to collect each sample. A portion of the sample material will be placed directly in two 40 milliliter vials for VOC analysis. The remaining material will be homogenized in dedicated or decontaminated stainless steel bowls. Large pieces of gravel will be removed before placing the soil in sampling containers. All samples will be preserved if appropriate, placed on ice to maintain a constant temperature of 4°C, and stored in coolers during shipment to the analytical laboratory(ies).

All of the surface soil samples will be screened at the on-site field laboratory for extractable petroleum hydrocarbons with a nondispersive infrared analyzer as described in Section 6.

Locations of samples will be selected in accordance with the source area specific requirements as discussed previously. Additional samples may be collected for field laboratory analysis where field observations indicate additional samples are appropriate.

5.2 SUBSURFACE SOIL

Subsurface soil samples will be collected from soil borings that will be drilled using a 3/8-inch I.D. hollow-stem auger. Location of the soil borings will be determined from the subsurface soil field laboratory analytical screening, local observations, and the rationale established in Section 2. Soil cores will be collected using a 18- or 24-inch long, 3-inch outside diameter

(O.D.) stainless split-tube sampler. Soil bores will be collected from each soil boring at 5-foot intervals, at changes in lithology, and at other locations at the discretion of the project geologist. The split-tube sampler will be driven by a 300-pound weight dropped through a 30-inch height interval. The procedures for split-tube sampling are described in American Society of Testing and Materials D1586 (ASTM 1984). The split-tube sample lithology will then be described in general accordance with ASTM D2488, MIL-STD-619B, and general descriptive techniques in Folk (1964) by a qualified geologist. After the lithology has been described, selected samples will be removed from the split-tube with a stainless steel spoon and placed directly into appropriate prelabeled sample containers for VOC analysis. The remainder of the samples collected will be packaged and preserved as appropriate for the remaining analyses. The split-tube sampler will be decontaminated between each 5-foot sample interval and auger flights will be decontaminated between each soil boring.

During and after drilling operations, all drill cuttings, soil cores, and soil samples, as well as the general breathing area around the drilling rig, will be screened initially for total VOCs with a hand-held PID/FID. After collection, all soil samples will be screened on-site for extractable petroleum hydrocarbons with a infrared analyzer.

The technical approach of the subsurface soil survey is to economize the sampling program by reducing the number of samples needed by bracketing sample locations. Bracketing involves selecting sample locations based on previous analytical results, increasing the number of samples in those areas that contain contamination, and terminating sampling in those areas where contamination is not detected. Bracketing is accomplished by first conducting a prioritized, sampling program until contamination is detected. The distribution of contamination is then delineated, and sampling commences. The sampling will be conducted as follows:

- Samples will be collected at 5-foot intervals to the top of the permafrost or until groundwater is encountered.
- In the absence of permafrost and contamination as determined by field laboratory analysis and/or screening by PID/FID, continuous samples will be collected until at least three consecutive soil samples exhibit no detectable contamination, as determined in the field laboratory analysis.
- A sample will be collected from the bottom of the soil boring to confirm that no contamination exists. This sample will be sent for confirmation analysis at the project laboratory.

- Soil borings will be terminated when groundwater is encountered. A soil sample will be collected at the groundwater interface, and depending on the area being investigated and the results of the field laboratory, the soil boring may be deepened for installation of a monitoring well.
- A maximum of two samples per soil boring will be sent to the project laboratory for confirmation of POL contamination. A minimum of one sample per soil boring will be sent to the project laboratory to similarly confirm absence of contamination.
- Depending upon the contamination detected in the soil boring, additional soil borings may be drilled in the area to identify areal extent of contaminants.

Permafrost will be encountered while drilling at OU-4, and may pose a problem with sample collection. Most sample locations will be selected in areas that are expected to be permafrost-free. A few subsurface soil sample locations will be chosen in areas that may contain permafrost, such as those located south, west, and east of the landfill. Additionally, permafrost may be encountered at depth at the CSY and FTPs. If it is encountered, the field team will proceed as follows:

- The soil boring will be prepared to be sealed in case flowing artesian groundwater conditions are encountered.
- The temperature at the bottom of the soil boring will be measured. The temperature of permafrost will reflect its stability.
- If the water table or a large talik is encountered, a subsurface soil sample will be collected immediately to determine if the aquifer contains dissolved contaminants.
- If the water table is not found and the sediments are still frozen for the allowed depth of drilling, drilling will stop, and two additional nearby locations may be drilled to collect alternative samples.
- If the additional locations are frozen, then the sample will not be collected.

Proper abandonment of the soil borings will be necessary to minimize groundwater contamination from hazardous materials encountered on the ground surface or in the subsurface. In addition, improperly abandoned soil borings can pose a physical threat to people and wildlife. All soil borings drilled during the remedial investigation will be backfilled to the surface with Pure Gold grout consisting of a uniform fluid admixture of bentonite and water. The grout must contain at least 30 percent solids by weight and have a density of 9.4 lbs/gallon or greater. An

identification cap or marker may be placed at the surface to aid in the surveying of the soil boring location.

5.3 GROUNDWATER

Sampling of groundwater in monitoring wells and/or water supply wells will consist of the following activities:

- Evaluation of monitoring well construction and evaluation of the integrity of the well if appropriate;
- Measuring depth to water level and total well depth (to calculate purge volume). For a domestic or water supply well, an estimate the water level and total well depth may be needed;
- Evacuating of water (purging);
- Measuring and recording of groundwater temperature, pH, conductivity, dissolved oxygen (DO), and reduction/oxidation potential (Eh); and
- Collecting of the groundwater samples.

Prior to sampling, a water interface probe will be used to determine the water level depth, and the depth of the bottom of the well. Equipment will be decontaminated between uses to avoid cross-contamination of wells.

The number of linear feet of static water (the standing water column) will be determined by calculating the difference between the static water level and the total depth of the well. The static volume will be calculated using the formula:

$$V = Tr^2(0.163)$$

Where:

- V = Static volume of well in gallons.
- T = Standing water column, measured in feet.
- r = Inside radius of well casing in inches.
- 0.163 = A constant conversion factor that compensates for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and π (pi).

A minimum of three volumes of the standing water column will be purged from each well prior to sample collection to ensure that the sample will be representative of the groundwater. If

the well does not recover quickly enough to permit the removal of three successive volumes, the well will be pumped or bailed dry and sampled immediately following a recovery sufficient to sample collection. Purging will be performed using decontaminated stainless steel or Teflon bailers or pumps. A disposable or decontaminated Teflon bailer or dedicated pump will be used to collect the groundwater sample. If bailing is utilized care will be taken to avoid surging and turbulent conditions in the standing water column. If a pump is utilized to sample, low flow rates will be used to minimize volatilization of organic compounds. Domestic or water supply wells will be sampled at the nearest spigot to the well pump. The spigot will be opened and water allowed to run until the pump has cycled at least three times or a minimum of 10 minutes running time. Purge water from the monitoring wells will be contained in 55-gallon 17-H/17-E drums. If the water is uncontaminated, based on laboratory results, the water will be applied to soil outside of the contaminated area. If the water is contaminated, it will be labeled and stored on-site until arrangements for appropriate disposal have been made. Before and after each sample is collected, the sampling apparatus will be decontaminated.

Groundwater and product sample collection procedures are outlined as follows:

- A decontaminated, or disposable Teflon bailer or dedicated pump will be used to collect groundwater samples from monitoring wells. Groundwater samples collected from domestic or water supply wells will be collected from the nearest spigot to the well.
- When transferring water from the sample collection device to sample containers, care will be taken to avoid agitating the sample, which promotes loss of VOCs and increases the DO content.
- For monitoring wells with dedicated bladder pumps, VOC samples will be collected with the pump on its lowest setting to maintain laminar flow to the best extent possible.
- The remaining groundwater samples will then be collected for the remaining identified parameters.
- VOC samples will be cooled immediately upon collection.
- Samples from monitoring wells to be analyzed for dissolved metals will be filtered in the field using a 0.45-micron filter and preserved with nitric acid prior to shipment for analysis. The filtering equipment will be decontaminated between samples to avoid cross-contamination or disposable equipment will be utilized.
- Any observable physical characteristics of the groundwater or product (e.g., color, sheen, odor, turbidity) will be recorded in the logbook.

- Groundwater temperature, pH, specific conductance, DO, and Eh will be measured and recorded.
- Weather conditions at the time of sampling will be recorded in the field logbook (e.g., air temperature, wind direction and velocity, recent heavy rainfall or drought conditions).

5.4 SURFACE WATER

Field measurements of pH, conductivity, and temperature at a minimum will be recorded prior to collection of each surface water sample. At a minimum, the pH and conductivity meters will be calibrated daily in the field using calibration standards. The pH meter will be calibrated using a 7.0 buffer and either a 4.0 or a 10.0 buffer, depending on the expected conditions. Conductance accuracy will be checked with a solution of known conductance and recalibrated, if necessary. The conductivity meter also will be temperature compensated.

Surface water samples will be collected moving from downstream to upstream locations in order to minimize the disturbance to sample locations. Surface water samples will be collected by submerging the sample container under water to fill the container. The samples will be collected in such a manner as to minimize agitation of the water. Agitation promotes the loss of VOCs and increases the DO content. Each sample will be chemically preserved (if appropriate) and sealed immediately after collection. Depth of water and depth of sample will be recorded at the time of collection. Flow rate will be estimated except in the case of the cooling pond. Physical characteristics of surface water (e.g., color, sheen, odor, turbidity) during the sampling period will be recorded.

Both filtered and unfiltered samples will be collected from each sample location. Filtered samples will be submitted for dissolved metals analyses. Filtering can be conducted using vacuum hand-pump filters. All samples will be preserved if appropriate, placed on ice to maintain a constant temperature of 4°C, and stored in coolers during shipment to the analytical laboratory(ies).

5.5 SEDIMENT

Sediment samples will be collected as grab samples from 6 inches below the sediment surface. Sediment samples will be collected moving from downstream to upstream locations to minimize the disturbance to sample locations. Dedicated or decontaminated stainless steel spoons will be used to collect the samples. A portion of the sample will be placed in two 40-mL vials

for VOC analysis. The remaining material will be homogenized in dedicated or decontaminated stainless steel bowls and placed in the remaining sample containers. All samples will be preserved if appropriate, placed on ice to maintain a constant temperature of 4°C, and stored in coolers during shipment to the analytical laboratory(ies).

Sediment samples will also be collected from the upper 1-inch sediment surface at wetlands near the landfill for whole sediment toxicity testing in the laboratory in addition to identified analytical parameters. The procedures for collection, storage, and laboratory testing of sediments will follow ASTM standard practices as described in:

- ASTM E 1391-90, Standard Guide for Collection, Storage, Characterization, and Manipulation of Sediments for Toxicological Testing; and
- ASTM E 1383-90, Standard Guide for Conducting Sediment Toxicity Test with Freshwater Invertebrates.

The following briefly describes the essential aspects of field collection and handling of the sediment samples, as summarized by the ASTM standard guides.

Sediment samples collected at random locations in the cooling pond may be accessed from a floating sampling craft.

5.5.1 Sample Collection Methods

A standard benthic grab (such as an Eckman) or core sampler will be used to minimize disruption of the sample. Multiple grabs or cores will be taken as necessary and composited to obtain sufficient volume. The sample will be thoroughly mixed in a stainless steel bowl. Large particles and obvious large organisms will be removed from the sample.

5.5.2 Sediment Characterization

Sediment samples will be divided into sediment subsamples for laboratory characterization of the following parameters: TOC, particle size, and total ammonia. The pH, Eh, and percent water of the sample will be determined from the laboratory analysis. Sediment characteristics will be noted in the field including texture, color, and organisms.

5.5.3 Sample Volume and Storage

The toxicity test sediment subsample will be transferred to a clean plastic or polyethylene 1-liter container for storage and transport. Two 1-liter containers will be collected at each location for toxicity testing. Exposure to air should be limited. Upon retrieval and mixing, the sediment samples will be transferred immediately into containers. Containers will be filled to the top, leaving no head space, and sealed air tight. Sediment samples will be cooled to 4°C in the field, and stored at 4°C for no longer than 2 weeks prior to the start of the laboratory toxicity test. Sediment samples will not be frozen at any time during storage. Sediment sample containers will be kept on ice during storage and transport.

5.5.4 Toxicity Tests Organisms

The sediment toxicity tests will employ two or three standard freshwater organisms for whole sediment testing as identified in the ASTM guidance such as *Hyalella azteca*, *Chironomus tentans*, or *C. riparius*.

5.6 AIR

All proposed air sample collection sites will be located 10 to 20 feet (or greater) from the landfill, buildings, piles, areas of heavy vegetation, or other obstructions. SOPs for air sampling at hazardous waste sites should be established and submitted by the contractor prior to field work. Collocated samplers will be positioned approximately 6 to 10 feet apart, facing the same direction.

Hi-vol PM10 will use 37 mm filters as the collection media. The EPA Reference Method for determination of the ambient concentrations of 10 μm particulates are given in 40 CFR, Part 50, Appendix J. This Reference Method requires drawing an air sample at a constant flow rate first through a size-selective inlet, where particles greater than 10 μm are removed, then through a filter medium. The filter medium is weighed before and after sample collection to determine the total mass of 10 μm particulates. Hi-vol PM10 samplers are operated at a flow rate of 5 liters per minute over a 24-hour sample period which is accurately timed. The mass concentration of 10 μm particles can be determined by the total volume of air sampled. The filters are digested and analyzed for metals.

TSP hi-vol samplers will use Whatman 41 cellulose filters as the collection media. All hi-vols will be positioned 2 meters above the ground at selected sample locations. Whatman filters

have a collection efficiency of approximately 99.0 percent for particulates greater than 0.3 μm in size. Cellulose filters contain very low levels of inorganics, making them appropriate for the collection of samples for metals analysis. The EPA Reference Method for determination of TSPs in the atmosphere is given in 40 CFR, Part 50.11, Appendix B. This Reference Method requires drawing an air sample at a constant flow rate through a filter medium. The mass concentration of TSPs in the ambient air can be computed by measuring the mass of collected particulates and the volume of air sampled. TSP hi-vols will be operated at a flow rate of 40 cubic feet per minute for 10 to 12 hour sampling intervals, depending on meteorological conditions.

Hi-vol sampling apparatuses will require generator power if line power is not available. Portable unleaded gasoline powered generators will be used to supply electrical power (if necessary) and will be positioned approximately 100 feet downwind of each hi-vol. The generators must be equipped with ground fault interrupters and will require refueling. Oil should be checked at each refueling.

Sampling procedures for both PM10 and hi-vol samplers is provided below:

- Calibrate samplers as per manufacturer's specifications;
- Secure PM10 samplers to stakes and position TSP samplers in desired sampling locations;
- Position generator at least 100 feet downwind of sampler (TSP hi-vols only);
- Allow samplers to run without filters for 5 minutes to warm up brushes;
- Record location, sample number, filter serial number, and calibration numbers in field logbook. Record sampler serial number and sample number on a flow recorder chart;
- Inspect filter for holes, tears, or irregularities;
- Prior to and following each sample collection, the samplers should be decontaminated.
- Load filter in sampler, inspect for leaks in systems;
- Set initial positive pressure set point determined during calibration using a water manometer and record pressure change;
- Program timer to stop sampling at desired stop time;
- Record start time and place flow recorder paper in flow recorder;

- At the end of the sample period, determine final positive pressure set point using water manometer and record pressure change;
- Remove filter from samplers, fold filter length-wise down the center so that only impregnated surfaces are in contact and place in individual manila envelopes, custody-seal, and ship to the fixed laboratory for analysis;
- Examine flow recorder for irregularities which may have affected air flow during sampling;
- Determine flow rate and elapsed time and enter on sample data sheet; and
- Determine final concentrations once laboratory data are available.

Preparation, extraction, and blank analysis of filters will be undertaken by the Special Analytical Services laboratory chosen by the ADCOE for this project. Laboratory analysis of Teflon filters will be implemented by proton induced X-ray emission, analysis of cellulose filters will be implemented by atomic adsorption, spectrometric detection.

Meteorological Parameters

To facilitate analytical data interpretation, meteorological data will be obtained 48 hours prior to the collection of samples. Necessary meteorological parameters include:

- Wind speed;
- Wind direction;
- Barometric pressure in mm Hg;
- Temperature in °K;
- Relative humidity; and
- Total precipitation.

Location of the meteorological station will be at an upwind location away from the landfill. An anemometer and directional wind vane will be placed atop a 20 foot tower. Wind direction data will be used to select upwind and downwind sample locations. Determination of temperature and barometric pressure are necessary to convert flow rates to standard condition, and instruments for collecting these data will be affixed to the tower.

The meteorological data will be representative of conditions on-site during the period of sampling. Changes in wind direction will be taken into account during sampling and hi-vol sampler locations may be adjusted to account for diurnal wind changes. Precipitation measurements are not needed for data calculations; however, samples will not be collected during periods of precipitation. Changes in meteorological conditions will be noted in the field logbook. Meteorological stations typically run 24 hours a day. They use very little battery power and the data can be transferred to a computer disk for later manipulation. The temperature and pressure recorded for the time of the air sampling will be used to obtain the average temperature and pressure for calibration purposes.

5.7 DECONTAMINATION PROCEDURES

When possible, disposable sampling devices will be used for field activities. Due to the number of samples to be collected, much of the sampling equipment used in the field will be decontaminated between uses at different sample locations. Proper personal protective equipment will be worn by personnel during equipment decontamination. Equipment anticipated for field decontamination includes but is not limited to:

- Stainless steel trowels, spatulas, and mixing bowls;
- Auger flights and hand-augers;
- Split-tube samplers; and
- Non-disposable protective equipment.

The intent of field decontamination is to prevent the cross-contamination of samples, control spread of contaminants to uncontaminated areas, and to prevent chemical exposure to the sampling team. Decontamination will be conducted in a central location, upwind and away from suspected contaminant sources. The decontamination procedures for all stainless steel and steel sampling equipment will consist of a consecutive series of the following washes and rinses:

- Scrape to remove all visible material,
- Scrub with brushes using a phosphate-free detergent (Liquinox),
- Rinse with potable water,

- Rinse with isopropyl alcohol,
- Rinse with potable water, and
- Air dry.

Auger flights will be pressure washed or steam cleaned and air dry. Non-disposable protective clothing will be washed with a water and Liquinox detergent solution, and will be rinsed with potable water. The Site-Specific Health and Safety Plan (SSHSP) presents procedures for personnel decontamination and site access control.

5.8 INVESTIGATION-DERIVED WASTE

The quantity of potentially hazardous investigation-derived wastes (IDW) is expected to be containerized into 55-gallon drums. IDWs will be containerized as necessary based upon results of previous sampling of the sites, upon visual examination and PID/FID headspace readings. IDWs are expected to consist of the following waste types:

- Drill cuttings from soil borings,
- Groundwater from well development,
- Wastewater from drilling operations,
- Decontamination fluids, and
- Disposable protective clothing and supplies.

Drill cuttings will be shoveled away from the auger during drilling and screened with an FID or PID. Those cuttings that contain greater than 50 ppm of organic vapors, as measured with a FID or PID, shall be treated as potentially contaminated and containerized in 55-gallon Department of Transportation (DOT) 17H/17E type drums. Those cuttings that contain less than 50 ppm of organic vapors will be stored on site separate from the potentially contaminated drill cuttings.

Groundwater produced during well development and sampling activities will be treated as potentially contaminated. All potentially contaminated groundwater will be containerized by the ADCOE in 55-gallon DOT 17H/17E type drums. The water will be tested for priority pollutant

metals, VOCs, semivolatile organic compounds, TPH, Pesticides/PCBs, herbicides, and dioxin. If analytical results indicate that contaminant levels exceed state or federal MCLs, the liquids will be treated prior to disposal.

All IDW containers (drums, tanks, and bags) will be labeled immediately with weatherproof labels securely affixed to the container. These wastes will be labeled as "Nonhazardous Wastes" (green label). The label shall contain a description of the waste, the soil boring or well designation from which it was generated, the site name, and the accumulation start date.

A suitable on-site location will be designated by the ADCOE project manager as the storage area for generated waste containers. All generated waste containers will be moved to this location by the ADCOE drilling crew prior to demobilization.

All information about the containers, including storage locations, volumes, descriptions, generation points, and accumulation start dates, will be recorded in the logbook. The contractor will provide a summary of this information to the ADCOE project manager within 60 days after fieldwork is completed.

If the results of the laboratory analyses of surface and subsurface soil samples indicate that the generated wastes are RCRA hazardous wastes, the containers will immediately be re-labeled by DPW as "Hazardous Wastes" (yellow label), and the date the sample results were received will be used as the new accumulation start date.

Disposal of all IDW stored on site will be the responsibility of ADCOE and the Defense Reutilization and Marketing Office (DRMO). Nonhazardous wastes will be disposed of in accordance with ADCOE and DPW guidelines. Hazardous wastes must be disposed of by DRMO within 90 days of the new accumulation start date. Nonhazardous disposable supplies will be bagged, stored, and disposed at a landfill.

5.9 INVESTIGATION-DERIVED WASTE DISPOSAL

All IDWs including steam cleaning wastes and decontamination solutions will be containerized in United States Department of Transportation (DOT)-approved 17-H/17-E 55-gallon drums, sealed, and properly labeled for hazardous waste disposal. The field sampling contractor is responsible for filling, sealing, decontaminating, labeling, and centrally locating the drums on wooden pallets on-site. The final disposition of the drums and their contents will be determined following receipt of the completed analytical results and after consultation with EPA Region 10.

6. FIELD LABORATORY

Prior to commencing sampling activities at the site, the project manager will notify the project and QA laboratories of the confirmed days on which sampling is to occur and when the samples are to be shipped for planned project laboratory analysis. The project manager will also confirm the sample documentation numbers, the number of samples to be shipped, the types of analyses required, and verify their arrival at the designated laboratories.

For the field investigation activities at OU-4, a field analytical laboratory will be required for on-site analysis of benzene, toluene, ethylbenzene, and xylenes (BTEX) in soil samples; and BTEX and trichloroethene (TCE) in water samples. The primary objectives of the field analyses are to provide analytical data in a timely manner for guidance of ongoing work in the field, and to optimize selection of samples to be submitted for project laboratory analysis.

6.1 SAMPLE HANDLING AND DOCUMENTATION

Soil and sediment samples to be analyzed on site for BTEX will be collected in 4-oz glass jars with Teflon-lined lids. Water samples to be analyzed on site for TCE will be collected in 40-mL volatile organic analyte (VOA) vials with Teflon-lined lids. All surface soil, subsurface soil, and water samples collected during the field investigation at OU-4 will be submitted to the field laboratory for analysis. Samples requiring on-site analysis will be assigned a unique sample number after collection. The sample numbering scheme is presented in Section 7.

As the samples are collected for field laboratory analysis, they will be recorded on a chain-of-custody form, which will be relinquished to the project chemist when they are hand-delivered to the on-site field laboratory. Upon receipt, the project chemist will log in the samples in a bound field logbook, designated as the Sample Log, sign the chain of custody form, and store the samples at 4°C in a secured area. The samples will be stored at 4°C for 7 days water/14 days soils after collection in the event that reanalysis of a sample is necessary. Prior to the designated

holding times, samples will either be disposed of with other investigation-derived material (e.g., drill cuttings) or sent to the fixed laboratory for confirmational analysis.

Submittals of confirmatory samples to a project laboratory for analysis will be as follows:

Surface Soils

- Designated surface soils will be submitted to the field laboratory for analysis and the project laboratory for confirmational analysis.
- Additional designated surface soils may be submitted to the field laboratory at the discretion of the project manager to aid in characterization of the contaminant plume.

Subsurface Soils

- A minimum of one sample and a maximum of two samples per soil boring will be submitted to the project laboratory.
- If samples collected from a soil boring are found to be uncontaminated by the on-site laboratory analysis, then one sample from the bottom of the soil boring will be submitted for confirmatory analysis.
- If the soil boring samples collected are found to be contaminated, the drilling will continue until groundwater is reached or drilling cannot continue (due to permafrost). In this case, two samples will be sent to the project laboratory for analysis: the sample with the highest concentration by the field analysis, and the sample from the bottom of the soil boring at the groundwater interface.

Groundwater Samples

- All monitoring wells samples will be submitted to the field laboratory and the project laboratory for analysis.

It is the responsibility of the project chemist to notify the project manager of samples approaching the designated holding times. The project manager will determine which samples are sent for analysis.

6.2 METHODOLOGY

Prior to field investigation activities, the contractor will provide SOPs for the field laboratory method and instrumentation. The ADCOE is responsible for establishing the requirements for the field laboratory and approving the methodology.

6.2.1 Field Analysis

TCE in groundwater samples and BTEX in soil/sediment samples will be analyzed using a field portable gas chromatograph. The portable field GC must be capable of performing purge and trap extraction for soil and water matrices; running temperature programs; and providing hard copies as well as diskette deliverable data.

The method will be provided in an SOP prior to field work initiation. It is to be used only by trained analysts, under the supervision of an experienced chemist.

The sample is analyzed using a calibrated purge and trap extraction/gas chromatography (GC)/Argon Ionization Detector (AID) system, according to manufacturer's instructions for instrument-specific operation.

6.2.2 Calibration Procedures

The instrument will be calibrated for target analytes based on suspected contaminants. The initial calibration must be generated for each target analyte by the analysis of a minimum of three standards which cover the linear range of the instrument. The calibration factor (CF) defined as the ratio of response (peak area or height) to mass injected is calculated for each target analyte. The percent relative standard deviation (%RSD) defined as the ratio of standard deviation to mean CF is calculated for each target analyte. The QC criteria for each target analyte %RSD must be less than or equal to 30 percent before sample analyses may begin.

The initial calibration must be verified with a continuing calibration standard at the beginning of each day of operation. A daily CF is calculated for each target analyte. A relative percent difference (RPD) value is calculated between the mean initial calibration CF and the continuing calibration CF. The QC criteria for each target analyte RPD must be less than or equal to 30 percent before sample analyses may begin.

6.2.3 Detection Limits

The instrument will be capable of detecting TCE in water samples down to 10 parts per billion (ppb) and BTEX and TCE in soil samples down to 5 parts per million (ppm).

6.2.4 Standard Operating Procedure

Specific SOPs will be provided by the contractor and will include:

- Instrumentation,
- Standards,
- Procedures,
- QC measures,
- Calculations, and
- Laboratory health and safety.

6.3 REPORTING

All calculations will be recorded in the field analytical logbook. Results will be recorded on a data reporting form by the project chemist. The results will be provided to the project manager on a real-time basis as they are obtained (usually within 24 hours of sampling) in order to guide ongoing field activity.

7. SAMPLE DOCUMENTATION AND RECORD KEEPING

This section describes the field sampling handling and record keeping requirements, including sample labeling and field log instructions.

7.1 SAMPLE IDENTIFICATION

All containers of samples collected will be identified using a 9 to 12 digit alphanumeric code on a label or tag fixed to the sample container. The alphanumeric code will be assigned to each sample as an identification number to track samples collected at the site. The sample code for project laboratory samples is broken down as follows.

Group	Digits	Description	Code Examples
(1)	1-2	Calendar Year	92, 93
(2)	3-7	IRP identifying code	LF (Landfill), CSY (Power Plant Coal Storage Yard), and FTP (Fire Training Pits)
(3)	8-10	Sample number	010, 110
(4)	11-12	<u>Sample type</u>	<u>Symbol</u>
		Sediment	SD
		Surface Water	SW
		Groundwater	GW
		Ash	AH
		Surface Soil	SS
		Subsurface Soil	SB
		Air	AR

Example: 92 LF 010 SS = 1992, Landfill, Sample No. 10, Surface Soil

Each sample will be labeled, chemically preserved, if required, and sealed immediately after collection. To minimize handling of sample containers, labels will be filled out prior to sample collection. The sample label will be filled out using waterproof ink and will be firmly affixed to the sample container and protected with Mylar tape. The sample label will include the following information:

- Initials of sampler,
- Date and time of collection,
- Sample number,
- Analysis required,
- pH (if applicable), and
- Preservation.

Samples collected for field laboratory analysis will be assigned an identification number using the following format.

Group	Digits	Description	Code Examples
(1)	1-2	Field laboratory designation	FL*
(2)	3-4	<u>Sample type</u> Surface soil Subsurface soil	<u>Symbol</u> SS SB
(3)	5-8	Area identifying number and sample number 1000 series Landfill 2000 series CSY 3000 series FTPs	1001

Example: FL-SB-3003 - A field laboratory subsurface soil sample from the FTPs area; the third sample collected for field analysis from this area.

* FL will be a constant.

A field laboratory sample that is sent to the project laboratory for analysis will be re-assigned an 9 to 12 alphanumeric number as described above, prior to shipment.

7.2 DAILY LOGS

Daily logs and data forms are necessary to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project and to refresh the memory of field personnel if called upon to give testimony during legal proceedings. All daily logs will be kept in a bound, waterproof notebook containing numbered pages. All entries will be made in waterproof ink, dated, and signed. No pages will be removed for any reason. Corrections will be made according to the procedures given at the end of this section.

The daily Site Log will be the responsibility of the project manager and will include a complete summary of the day's activity at the site. The log will include:

- Name of the person making entry (signature).
- Names of team members on-site.
- Levels of personnel protection:
 - Level of protection originally used;
 - Changes in protection, if required; and
 - Reason for changes.
- Time spent collecting samples.
- Documentation on samples taken, including:
 - Sampling date;
 - Sampling location and depth station numbers;
 - Sampling personnel;
 - Type of sample (grab, composite, etc.); and
 - Sample matrix.
- On-site measurement data.
- Field observations and remarks.
- Weather conditions, wind directions, etc.
- Unusual circumstances or difficulties.
- Initials of person recording the information.

7.3 CORRECTIONS TO DOCUMENTATION

7.3.1 Field Notebook As with any data logbooks, no pages will be removed for any reason. If corrections are necessary, these must be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside. The correction must be initialed and dated. Some corrected errors will require a footnote explaining the correction.

7.3.2 Sampling Forms

As previously stated, chain-of-custody records, and other forms must be written in water-proof ink. None of these documents are to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on a document assigned to one individual, that individual may make corrections simply by crossing a line through the error and entering the corrected information. The incorrect information should not be obliterated. An subsequent error discovered on a document should be corrected by the person who made the entry. All corrections must be initialed and dated.

7.3.3 Photographs

Photographs will be taken as directed by the project manager. Documentation of a photograph is crucial to its validity as a representation of an existing situation. The following information will be noted in the field logbook concerning photographs:

- Date, time, location photograph was taken;
- Photographer;
- Weather conditions;
- Description of photograph taken;
- Reasons why photograph was taken;
- Sequential number of the photograph and the film roll number; and
- Camera lens system used.

After the photographs have been developed, the information recorded in the field logbook should be transferred to the back of the photographs.

7.4 SAMPLE HANDLING, PACKAGING, AND SHIPPING

The transportation and handling of samples must be accomplished in a manner that not only protects the integrity of the sample, but also prevents any detrimental effects to sample handlers due to the possible hazardous nature of samples. Regulations for packaging, marking, labelling, and shipping hazardous materials are promulgated by the DOT in the Code of Federal Regulations, 49 CFR 171 through 177, and/or the International Air Transport Association regulations for Dangerous Goods.

7.4.1 Sample Packaging

Samples must be packaged carefully to avoid breakage or contamination and must be shipped to the laboratory at proper temperatures. The following sample package requirements will be followed:

- Sample bottle lids must never be mixed. All sample lids must stay with the original containers.
- The sample volume level can be marked by placing the tip of the label at the appropriate sample height, or with a grease pencil. This procedure will help the laboratory to determine if any leakage occurred during shipment. The label should not cover any bottle preparation QA/QC lot numbers.
- All sample bottles are placed in a plastic bag to minimize leakage in the event a bottle breaks during shipment.
- The environmental samples are to be cooled. The use of ice sealed in plastic bags is preferred over artificial icing materials. Ice is not to be used as a substitute for packing materials.
- Any remaining space in the cooler should be filled with inert packing material. Under no circumstances should material such as sawdust, newspaper, sand; etc., be used.
- The custody record must be placed in a plastic bag and taped to the bottom of the cooler lid. Custody seals must be affixed to the sample cooler.

7.4.2 Shipping Containers

Shipping containers are to be custody-sealed for shipment as appropriate. The container closure will consist of filament tape wrapped around the package at least twice and in two places and custody seals affixed in such a way that access to the container can be gained only by cutting the filament tape and breaking a seal.

Field personnel will make arrangements for transportation of samples to the field laboratory or project analytical laboratory. When custody is relinquished to a shipper, field personnel will telephone the laboratory sample custodian, to inform him/her of the expected time of arrival of the sample shipment and to advise him/her of any time constraints on sample analysis.

7.4.3 Marking and Labeling

The marking and labeling for shipping containers should follow the guidance presented below.

- Use abbreviations only where specified.
- The words "This End Up" or "This Side Up" must be clearly printed on the top of the outer package. Upward pointing arrows should be placed on the sides of the package. The words "Laboratory Samples" should also be printed on the top of the package.
- After a shipping container has been sealed, two chain-of-custody seals are placed on the container, one on the front and one on the back. The seals are protected from accidental damage by placing mylar tape over them.
- If samples are designated as medium or high hazard, they must be sealed in metal paint cans, placed in the cooler with vermiculite and labeled and placarded in accordance with DOT regulations.
- In addition, the coolers must be labeled and placarded in accordance with DOT regulations if shipping medium and high hazard samples.

8. DATA VALIDATION AND REDUCTION

Facility-specific QA/QC and a summary of analytical methods to be employed are described in the QAPjP for OU-4. The QAPjP outlines a QA program that will ensure that all technical data generated are accurate, representative, and will ultimately withstand judicial scrutiny.

All field analytical data should be evaluated by a validation specialist for precision, accuracy, and completeness. Specific procedures for data validation are included in the QAPjP. Existing data for the CSY and 10 percent of project laboratory analytical data collected during the RI will be validated to Level IV requirements.

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Appendix B
QUALITY ASSURANCE PROJECT PLAN

**QUALITY ASSURANCE PROJECT PLAN
FOR
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
AT
OPERABLE UNIT 4
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

April 1993

Prepared for:

**UNITED STATES ARMY CORPS OF ENGINEERS
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SIGNATURE PAGE

Contractor Project Manager

Date

Contractor QA Officer

Date

ADCOE Project Manager

Date

ADCOE QA Officer

Date

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1. INTRODUCTION

This Quality Assurance Project Plan (QAPjP) has been prepared for remedial investigation (RI) and feasibility study (FS) activities at Operable Unit 4 (OU-4), Fort Wainwright, Fairbanks, Alaska. The RI/FS activities are being conducted under contract to the United States Army Corps of Engineers, Alaska District (ADCOE). The QAPjP addresses requirements set forth in United States Environmental Protection Agency (EPA) Interim Guidelines for the Preparation of Quality Assurance Project Plans (QAMS-005/80). This formal guidance will be used to ensure the validity of data generated for this project. The QAPjP includes descriptions of project management, sampling equipment and procedures, and analytical procedures and quality assurance (QA) requirements that will be used to obtain valid, representative field samples and measurements. Strict adherence to quality control (QC) protocol, as presented in Chapter 1 of EPA Test Methods for Evaluating Solid Waste (SW-846), is required. Prior to initiation of project operations, ADCOE will submit the name of the laboratory and the laboratory's QA/QC project plan to EPA for review and approval, in accordance with QAMS-005/80.

This QAPjP will be used in conjunction with the implementing contractor's QA Program Plan. The contractor's QA Program Plan will include:

- Specific QA policies;
- Project QA organization;
- QA objectives;
- Functional activities; and
- QA/QC procedures and standard operating procedures (SOPs).

1.1 PROJECT DESCRIPTION

Specific activities to be conducted in support of the RI at OU-4 will include the following:

- Performance of geophysical surveys to confirm extent of permafrost and locate subsurface utilities;
- Collection and field analysis of surface and subsurface soils from various locations in order to determine subsequent sample locations;
- Collection and laboratory analysis of surface and subsurface soils from various locations in order to determine the extent of contamination;
- Collection and laboratory analysis of sediments in order to determine the extent of contamination;
- Collection and field analysis of groundwater and surface water from various locations in order to determine subsequent sample locations;
- Collection and analysis of surface water and groundwater from the site in order to characterize the water quality and groundwater/surface water relationships; and
- Collection of information with which to estimate the amount of contamination and develop remedial action alternatives.

A detailed project description including site background information is presented in Section 2 of the Management Plan.

1.2 SCOPE AND DATA USE

Data collected during the RI will be used to conduct an assessment of risks, including documentation of contaminant concentrations and physical characterizations of potential contaminant migration pathways. All chemical data to be used for the risk assessment and for characterizing the extent and degree of contamination will be of the highest quality appropriate, as prescribed by analytical methods detailed in this QAPjP and data quality objectives (DQOs) defined in Section 4 of the Management Plan.

Data use requirements have been used to develop the DQOs. A detailed discussion of sampling rationale, the number of samples to be collected, and sampling locations is provided in the Sampling and Analysis Plan (Appendix A). Field and analytical methodology requirements associated with project parameters are presented in Section 7 herein.

2. PROJECT ORGANIZATION AND RESPONSIBILITIES

All RI/FS activities will be directed by the United States Army, 6th Infantry Division (Light). Upon selection of a contractor, an organization chart will be submitted to EPA for review and approval. The following are suggested key contractor positions and responsibilities.

2.1 PROJECT MANAGER AND PROJECT DIRECTOR

The project manager will be responsible for implementing the RI/FS and will have the authority to commit the resources necessary to meet RI/FS objectives and requirements. The project manager's primary function is to ensure that technical, financial, and scheduling objectives are achieved successfully. The project manager will report directly to ADCOE and will provide the major point of contact and control for matters concerning the project. The project manager will:

- Define project objectives and develop a detailed work plan;
- Establish project policy and procedures to address the specific needs of the project as a whole, and the objectives of each task;
- Acquire and apply technical and corporate resources as needed to ensure performance within budget and schedule constraints;
- Monitor and direct field work;
- Develop and meet ongoing project and/or task staffing requirements, including a mechanism to review and evaluate the products of each task;
- Ensure that contractor project personnel and subcontractors are aware of the project QA objectives;
- Review the work performed on each task to ensure its quality, responsiveness, and timeliness;

- Review and analyze overall task performance with respect to planned requirements and authorization;
- Approve all external reports before their submission to ADCOE;
- Ultimately be responsible for the preparation and quality of interim and final reports; and
- Represent the project team at meetings and public hearings.

The project director will have overall responsibility for ensuring that work on OU-4 meets client objectives. In addition, the director will be responsible for technical QC and project oversight.

2.2 QUALITY ASSURANCE OFFICER

The QA officer will be responsible for ensuring QA objectives are met for the site. The QA officer will provide an external, thereby independent, QA function. Responsibilities will include coordinating with project management personnel to ensure that QC procedures appropriate to demonstrating data validity and sufficient to meet QA objectives are developed and in place.

2.3 SENIOR PROJECT CHEMIST AND PROJECT CHEMIST

The senior project chemist will be responsible for planning and oversight of the field laboratory operations and for defining field analytical and QA/QC procedures. He or she will provide guidance for initial field laboratory set-up and will be available to provide assistance with laboratory troubleshooting on a day-to-day basis. Following completion of field laboratory operations, the senior project chemist will be responsible for reviewing all data reports and summaries generated by the project chemist.

The project chemist will be responsible for initial set-up of the field laboratory operations and assessment of data usability. In addition, the project chemist will generate data reports which will provide sample results and all associated instrument's calibration and QA/QC information. The senior project chemist and project chemist are responsible only for field analysis and field laboratory procedures. USACE North Pacific Division Laboratory will review project and QA data and prepare the QA report.

3. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

3.1 PROJECT OBJECTIVES

The overall DQO is to produce data of known and documented quality with analytical results equivalent to EPA's Contract Laboratory Program (CLP) for Routine Analytical Services (RAS). The objective was determined primarily based upon EPA-defined project requirements to produce measurement data appropriate for risk-based analysis.

Data generated as part of the OU-4 RI/FS will be used to:

- Identify the extent of on-site contamination in soil, sediment, groundwater, and surface water;
- Define and characterize the amount and direction of contaminant migration;
- Identify risks posed by existing contaminants to human health and the environment; and
- Evaluate various remedial alternatives to mitigate or eliminate existing and potential risks.

Specific tasks have been identified to meet the objective. Specific analytical applications to achieve this objective include field analysis for benzene, toluene, xylene, and ethylbenzene (BTEX), and trichloroethene (TCE), field measurements, and laboratory analytical chemical and physical testing. All field screening and laboratory analytical testing will be arranged for and validated by ADCOE. Measurements that will be discussed in this report include field screening for BTEX and TCE with a portable gas chromatograph equipped with an argon ionization detector and field measurements of temperature, pH, conductivity, reduction/oxidation (redox) potential, dissolved oxygen, and static water level.

3.2 PROJECT-SPECIFIC QUALITY ASSURANCE OBJECTIVES

Specific analytical parameters for data collected during RI/FS activities at OU-4 are summarized in Table 3-1. Analytical parameters, technical methods, quantitation limits, and completeness goals are listed for all measurements. Accuracy and precision limits are included for all analytes except petroleum hydrocarbon classification. Those limits will be provided by the ADCOE project laboratory for the applicable methodology and will be used for data validation purposes.

The QA objectives presented in Table 3-1 are summarized in terms of precision, accuracy, representativeness, completeness, and comparability (PARCC) of data to be collected and analyzed during the RI/FS activities. These parameters are described below.

Accuracy. Accuracy is a measure of the closeness of an individual measurement or an average of a number of measurements to the true value. Accuracy is usually calculated in terms of percent recovery (%R) of a known value. This "known" can take the form of EPA or National Institute of Standards and Technology-traceable standards, laboratory-prepared solutions of target analytes or solutions of surrogate compounds spiked into each sample.

Precision. Precision is the agreement between a set of replicate measurements without assumption of knowledge of the true value. It is a measure of the variability in repeated measurements of the sample compared to the average value. The precision assessment should represent the variability of sampling, sample handling, preservation, storage, and analysis of the environmental measurement data. Precision is reported as relative percent difference (RPD), the difference divided by the average of two positive sample results.

The overall precision is a mixture of sampling and laboratory variability. Laboratory duplicate and field duplicate analyses are used to determine precision, with laboratory duplicate RPDs providing a measure of analytical precision and field duplicate RPDs providing a measure of overall precision.

Completeness. Completeness is the measure of how the amount of valid (usable) data obtained from a measurement system compare to the expected amount. Completeness is calculated after all analytical data have been reviewed for usability and is expressed as a decimal or percent usable data (usable data divided by total possible data).

Representativeness. Representativeness expresses the degree to which data accurately and precisely represent a characteristic of population, parameter variations at a sampling point, a process condition, or an environmental condition.

Representativeness is addressed by describing sampling techniques and the rationale used to select sampling locations. Sampling locations can be biased (based on existing data, instrument surveys, observations, etc.) or unbiased (completely random or stratified-random approaches).

Comparability. Comparability expresses the confidence with which one data set can be compared to another data set. All data in the RI/FS should be self-consistent (i.e., internally directly comparable). Whenever possible, data produced during the RI/FS should be comparable to other data produced for other site investigations using similar sampling techniques and the specific analytical procedures used for this project.

Table 3-1
SUMMARY OF LABORATORY QUALITY ASSURANCE OBJECTIVES

Parameters	Technical Method	Sample Matrix	Quantitation Limit ⁽¹⁾	Method Accuracy ⁽²⁾ (percent)	Method Precision ⁽²⁾ (percent)	Completeness (percent)
Benzene, toluene, ethylbenzene, xylene, trichloroethene	Field portable gas chromatography ⁽³⁾	Soil Water	~ 5.0 - 10.0 µg/L (water) 5.0 mg/kg (soil)	To be determined	To be determined	80
Total Recoverable Petroleum Hydrocarbons (TRPH)	EPA ⁽⁴⁾ Method 418.1	Soil	10 mg/kg	75-125	±35	90
		Water	1 mg/L		±20	90
Volatile Organic Compounds (VOCs)	SW-846 ⁽⁵⁾ Method 8260	Soil	5-100 µg/kg	59-172 ⁽⁷⁾ (59-138) ⁽⁸⁾ 61-145 ⁽⁷⁾ (76-115) ⁽⁸⁾	21-24	90
		Water	5-100 µg/L		11-14	
VOCs	EPA-DW ⁽⁶⁾ 524.2	Drinking water	0.2-3.5 µg/L	61-145 ⁽⁷⁾ (76-115) ⁽⁸⁾	11-14	90
Semivolatile Organic Compounds (add Tetrahydrofuran to landfill samples)	SW-846 Method 8270	Soil/Ash	330-1,600 µg/kg	11-142 ⁽⁷⁾ (19-137) ⁽⁸⁾ 9-127 ⁽⁷⁾ (10-141) ⁽⁸⁾	28-50	90
		Water	10-100 µg/L		28-50	
Semivolatile Organic Compounds	EPA-DW ⁽⁶⁾ 525	Drinking water	0.1-15 µg/L	9-127 ⁽⁷⁾ (10-141) ⁽⁸⁾	28-50	90
Pesticides/PCBs	SW-846 Method 8080 EPA Method 608	Soil/Ash	1.0-50.0 µg/kg	31-157 ⁽⁷⁾ 18-149 ⁽⁷⁾	31-50	90
		Water	.025-1.0 µg/L		15-27	
Pesticides/PCBs	EPA-DW Method 505	Drinking Water	.01-15 µg/L	18-149 ⁽⁷⁾	15-27	90
Dioxin	SW-846 Method 8290	Water	.01 - 2 ng/L	Varies	Varies	90
		Ash Soil	1.0 - 200 ng/kg	Varies	Varies	90

Table 3-1
SUMMARY OF LABORATORY QUALITY ASSURANCE OBJECTIVES

Parameters	Technical Method	Sample Matrix	Quantitation Limit ⁽¹⁾	Method Accuracy ⁽²⁾ (percent)	Method Precision ⁽²⁾ (percent)	Completeness (percent)
Petroleum Hydrocarbon Classification	SW-846 8015, Modified ⁽⁹⁾	Soil Water	~ 0.1 - 1.0 mg/kg ⁽⁹⁾ ~ 0.1 mg/L	Laboratory Specific ⁽⁹⁾	Laboratory Specific ⁽⁹⁾	90
Chlorinated Herbicides	SW-846 Method 8150	Soil/Ash Water	1 mg/kg .5 µg/L	75-125	40	90
Metals, Total and Dissolved						
Lead	SW-846 7421 EPA 239.2 ⁽⁴⁾	Air Soil/Ash Water	3.5E-5 µg/m ³ 0.5 mg/kg 1.0 µg/L	75-125	±35 ±35 ±20	90
Antimony	SW-846 6010 EPA 200.7	Air Soil/Ash Water	0.1 µg/m ³ 6.0 mg/kg 50 µg/L	75-125	±35 ±35 ±20	90
Arsenic	SW-846 7060 EPA 206.2	Air Soil/Ash Water	5.5 E-3 µg/m ³ 0.5 mg/kg 1.0 µg/L	75-125	±35 ±35 ±20	90
Barium	SW-846 6010 EPA 200.7	Air Soil/Ash Water	0.05 µg/m ³ 2.0 mg/kg 10 µg/L	75-125	±35 ±35 ±20	90
Beryllium	SW-846 6010 EPA 200.7	Air Soil/Ash Water	1.0E-4 µg/m ³ 0.5 mg/kg 0.6 µg/L	75-125	±35 ±35 ±20	90
Cadmium	SW-846 6010 EPA 200.7	Air Soil/Ash Water	1.0E-4 µg/m ³ 0.5 mg/kg 5.0 µg/L	75-125	±35 ±35 ±20	90

Table 3-1

SUMMARY OF LABORATORY QUALITY ASSURANCE OBJECTIVES

Parameters	Technical Method	Sample Matrix	Quantitation Limit ⁽¹⁾	Method Accuracy ⁽²⁾ (percent)	Method Precision ⁽²⁾ (percent)	Completeness (percent)
Gas-Range Organics	ADEC modification of SW-846 Method 8015 ⁽¹²⁾	Soil Water	5.0 mg/kg 0.1 mg/L	50-150	±35	90
Diesel-Range Organics	ADEC Method AK.102 ⁽¹³⁾	Soil Water	4.0 mg/kg 0.1 mg/L	65-135	20±	90
Chromium	SW-846 6010 EPA 200.7	Air Soil/Ash Water	2.0E-5 µg/m ³ 1.0 mg/kg 10 µg/L	75-125	±35 ±35 ±20	90
Copper	SW-846 6010 EPA 200.7	Air Soil/Ash Water	10 µg/m ³ 2.0 mg/kg 10 µg/L	75-125	±35 ±35 ±20	90
Mercury	SW-846 7471 EPA 245.1	Air Soil/Ash Water	3.0E-2 µg/m ³ 0.1 mg/kg 0.2 µg/L	75-125	±35 ±35 ±20	90
Nickel	SW-846 6010 EPA 200.7	Air Soil/Ash Water	0.7 µg/m ³ 2.0 mg/kg 10 µg/L	75-125	±35 ±35 ±20	90
Selenium	SW-846 7740 EPA 270.2	Air Soil/Ash Water	0.15 µg/m ³ 0.5 mg/kg 1.0 µg/L	75-125	±35 ±35 ±20	90
Silver	SW-846 6010 EPA 200.7	Air Soil/Ash Water	0.15 µg/m ³ 1.0 mg/kg 6.0 µg/L	75-125	±35 ±35 ±20	90
Thallium	SW-846 7841 EPA 279.2	Air Soil/Ash Water	2.5E-2 µg/m ³ 0.5 mg/kg 1.0 µg/L	75-125	±35 ±35 ±20	90

Table 3-1
SUMMARY OF LABORATORY QUALITY ASSURANCE OBJECTIVES

Parameters	Technical Method	Sample Matrix	Quantitation Limit ⁽¹⁾	Method Accuracy ⁽²⁾ (percent)	Method Precision ⁽²⁾ (percent)	Completeness (percent)
Zinc	SW-846 6010 EPA 200.7	Air Soil/Ash Water	70 $\mu\text{g}/\text{m}^3$ 1.0 mg/kg 5.0 $\mu\text{g}/\text{L}$	75-125	± 35 ± 35 ± 20	90
Iron	SW-846 6010	Air Soil/Ash	20,000 $\mu\text{g}/\text{m}^3$ 5.0 mg/kg	75-125	± 35	90
Manganese	SW-846 6010	Air Soil/Ash	0.4 $\mu\text{g}/\text{m}^3$ 1.0 mg/kg	75-125	± 35	90
Aluminum	SW-846 6010	Air Soil/Ash	1,100 $\mu\text{g}/\text{m}^3$ 10 mg/kg	75-125	± 35	90
Calcium	SW-846 6010	Air Soil/Ash	20,000 $\mu\text{g}/\text{m}^3$ 50 mg/kg	75-125	± 35	90
Cobalt	SW-846 6010	Air Soil/Ash	.01 $\mu\text{g}/\text{m}^3$ 2.0 mg/kg	75-125	± 35	90
Magnesium	SW-846 6010	Air Soil/Ash	20,000 $\mu\text{g}/\text{m}^3$ 50 mg/kg	75-125	± 35	90
Potassium	SW-846 6010	Air Soil/Ash	20,000 $\mu\text{g}/\text{m}^3$ 70 mg/kg	75-125	± 35	90
Sodium	SW-846 6010	Air Soil/Ash	20,000 $\mu\text{g}/\text{m}^3$ 50 mg/kg	75-125	± 35	90
Vanadium	SW-846 6010	Air Soil/Ash	.026 $\mu\text{g}/\text{m}^3$ 2.0 mg/kg	75-125	± 35	90
Total Organic Carbon	SW-846 9060 EPA 415.1	Soil Water	10 mg/kg 1 mg/L	75-125	± 35 ± 20	90

Table 3-1
SUMMARY OF LABORATORY QUALITY ASSURANCE OBJECTIVES

Parameters	Technical Method	Sample Matrix	Quantitation Limit ⁽¹⁾	Method Accuracy ⁽²⁾ (percent)	Method Precision ⁽²⁾ (percent)	Completeness (percent)
Alkalinity	EPA 310.1	Water	1 mg/L as CaCO ₃	N/A	±10	90
Nitrate-Nitrite	EPA 353.2	Water Soil	1 mg/L 1 mg/kg	75-125 75-125	±20 ±35	90
Biochemical oxygen demand	EPA 405.1	Water	2 mg/L	75-125	±35	90
Total Dissolved Solids	EPA 160.1	Water	10 mg/L	N/A	N/A	90
Atterberg Limits	ASTM D4318 ⁽¹⁰⁾	Soil	N/A	N/A	N/A	90
Moisture	ASTM D2216	Soil	N/A	N/A	N/A	90
Grain Size	ASTM D421, D422	Soil	1.001 mm	N/A	N/A	90
Specific Gravity of Soil Solids	ASTM D854	Soil	N/A	N/A	N/A	90
Sediment Toxicity Tests	ASTM E 1391-90 E 13830-90	Sediment	N/A	N/A	N/A	90
Phosphorus	EPA 365.2	Soil	Varies	75-125	±35	90
Potassium	SW-846 Method 7610	Water	0.01 mg/L	75-125	±10	90
Major Cations (Dissolved)	I-1472-85 ⁽¹¹⁾	Water	0.01-0.1 mg/L	75-125	±10	90
Major Anions (Dissolved)	I-2058-85 ⁽¹¹⁾	Water	0.01-0.1 mg/L	75-125	±10	90
Explosive Residue	SW-846 Method 8330	Water	.02-13 µg/L	75-125	±10	90

Table 3-1

SUMMARY OF LABORATORY QUALITY ASSURANCE OBJECTIVES

Parameters	Technical Method	Sample Matrix	Quantitation Limit ⁽¹⁾	Method Accuracy ⁽²⁾ (percent)	Method Precision ⁽²⁾ (percent)	Completeness (percent)
<p>(1) - Quantitation limits may be adjusted for sample weight and sample dilution. Quantitation limits are typical attainable method quantitation limits. Actual laboratory reporting limits may differ from those listed.</p> <p>(2) - Accuracy and precision objectives are based on Contract Laboratory Program Routine Analytical Services methods (except petroleum hydrocarbons). Actual documented laboratory-established precision and accuracy may be used if applicable.</p> <p>(3) - Method will be provided by contractor prior to field investigation.</p> <p>(4) - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.</p> <p>(5) - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste", SW-846, Revision 0, September 1986.</p> <p>(6) - Methods are contained in EPA "Methods for the Determination of Organic Compounds in Drinking Water", EPA-600/4-88/039, December 1988.</p> <p>(7) - This range is the lowest acceptable percent recovery for any of the matrix spike compounds to the highest acceptable percent recovery for any of the matrix spike compounds.</p> <p>(8) - This range is the lowest acceptable percent recovery for any of the surrogate compounds to the highest acceptable percent recovery for any of the surrogate compounds.</p> <p>(9) - The modification to Method 8015 will be the United States Army Corps of Engineers proposed method. Precision and accuracy objectives and detection limits will be determined by the project laboratory.</p> <p>(10) - Methods are contained in American Standards for Testing Materials.</p> <p>(11) - Methods are contained in USGS Methods for Determination of Inorganic Substances in Water and Fluvial Sediments, 1989.</p> <p>(12) - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline Range Organics, Revision 5, February 1992, Juneau, Alaska.</p> <p>(13) - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics (DRO), Revision 2, February 5, 1993, Juneau, Alaska.</p>						

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4. SAMPLING PROCEDURES

The RI/FS activities scheduled at OU-4 will include a geophysical survey, a surface and subsurface soil sampling program, a sediment sampling program, monitoring well installation, and a water (groundwater and surface water) sampling program. Soil sample analyses will be performed both in the field and in on-site and off-site laboratories. Required sampling techniques and all sample locations are included in the SAP (Appendix A). Specific SOPs for each activity will be required prior to the initiation of fieldwork. The required SOPs are listed in Section 4.2.

4.1 GENERAL FIELD ACTIVITIES

The following general field activities will be conducted.

Terrain Conductivity Survey

Prior to commencement of drilling activities, a geophysical survey will be conducted using a Geonics EM31-D conductivity meter. The EM31-D will be used to identify the presence of permafrost at areas proposed for soil boring and monitoring well installation.

Subsurface Line/Pipe/Tank Location

Prior to commencement of drilling activities, a geophysical survey will be conducted using ground-penetrating radar (GPR) to locate buried pipes and tanks in the immediate area of drilling locations.

Subsurface Soil Sampling

Prior to the start of sampling work, all drilling tools and equipment will be decontaminated with high pressure steam or an appropriate detergent. All drilling and sampling equipment to be

reused will be decontaminated between sampling locations. Where possible and appropriate, clean disposable equipment will be used in order to minimize the potential for cross-contamination.

Subsurface sampling will be conducted according to contractor-provided SOPs for soil boring sampling and soil sampling using split-tube samplers.

The lithologic character of each soil boring will be interpreted and logged using United States Geological Survey and Folk classification by a professional geologist, according to contractor-provided SOPs for geologic logging.

As split-tubes are retrieved, the soils will be collected into 40-mL volatile organic analyte (VOA) vials and analyzed with a field portable gas chromatograph with an argon ionization detector for BTEX and TCE. The analytical results along with visual observations will be used to determine which samples require project laboratory analysis. A maximum of two samples per boring (the two with the highest field analytical results) will be submitted for project laboratory analysis for parameters defined in Section 7.2.

Monitoring Well Construction and Installation

Monitoring well construction will comply with appropriate regulatory requirements regarding access, drilling, groundwater extraction, and disposal of derived wastes. Shallow boreholes and monitoring wells will be drilled using hollow stem augers. Hollow-stem drilling involves advancing a bit attached to an appropriate diameter auger without use of drilling fluid. When the desired depth is achieved, the well pipe is installed through the hollow center of the auger flights. Advantages of this method include:

- Prevention of borehole caving;
- Prevention of fluid circulation problems; and
- Ability to drill without introducing drilling fluids into the formation.

Monitoring wells will be constructed and developed according to contractor-prepared SOPs. Following installation of the wells, hydrogeological tests will be conducted to estimate the hydraulic conductivity and transmissivity of the aquifer. Field tests will include slug tests and constant discharge pump tests where recovery data will be used for estimating parameters of conductivity and transmissivity. These tests will be completed following contractor-provided SOPs for slug tests and controlled pumping tests.

Groundwater Sampling

In each well sampled, depth to groundwater will be measured to the nearest 0.01 foot using an electric sounder. The groundwater sample collected will be analyzed to determine temperature, pH, conductivity, redox potential, and dissolved oxygen. Groundwater samples will also be analyzed in the field for BTEX and TCE using a field portable gas chromatograph with an argon ionization detector.

Surface Soil and Sediment Sampling

Surface soil collection is discussed in detail in Appendix A. Unused disposable or decontaminated sampling implements will be used for sample collection. During the collection of each surface soil or sediment sample, observable physical characteristics of the material will be recorded.

Ash Sampling

At the landfill, ash samples will be collected using the same sampling procedure as surface soil sampling. The sample collection procedures and sample locations are discussed in Appendix A.

Surface Water Sampling

Surface water collection and sampling locations are discussed in Appendix A. Surface water will be tested in the field to determine temperature, pH, conductivity, redox potential, and dissolved oxygen. In addition, samples will be collected for laboratory analyses.

Air Sampling

Air sample collection is discussed in Appendix A. Air samples will be collected using high volume PM-10 air samplers and total suspended particle samplers to determine health risks associated with the air pathway and to identify inorganic contaminants migrating off-site.

Sampling and Drilling Equipment Decontamination

Where possible, disposable sampling and personnel protective equipment will be used to avoid any possibility of cross-contamination. Non-disposable sampling equipment will be decontaminated between each use by the following method:

- Wash in detergent solution;
- Rinse with clean water;
- Rinse with isopropyl alcohol; and
- Rinse with deionized organic-free water.

Drilling equipment that comes into contact with soil will be decontaminated by steam cleaning between drilling locations.

Investigation-Derived Waste Disposal

It is anticipated that the following types of investigation-derived waste will be generated:

- Disposable clothing;
- Decontamination solutions;
- Drill cuttings;
- Steam cleaning wastes;
- Well development and purge waters;
- Sample extracts; and
- Extracted soil samples.

All investigation-derived wastes will be containerized and segregated by waste type in United States Department of Transportation (DOT)-approved 55-gallon drums or temporary storage tanks; the drums/tanks will be sealed and labeled. The contractor will be responsible for filling, sealing, labeling, and storing the drum/tank on-site according to ADCOE direction. The final disposition of the drums/tanks and their contents will be determined following receipt of completed analytical results.

4.2 STANDARD OPERATING PROCEDURES

Applicable SOPs for completing these tasks and other associated tasks include:

- Health and Safety Procedures
- Site Entry Procedures
- Decontamination
- Emergencies Due to Heat/Cold and Stress Monitoring
- Personnel Decontamination
- Health and Safety on Drilling Rig Operations
- Health and Safety in Field Laboratories
- Review/Validation of Analytical Data
- Air Sampling
- Sample Packaging/Shipping
- Site Monitoring
- Equipment Calibration/-Operation
- Documentation
- Management of Investigation-Derived Waste
- Field Activity Logbooks
- Surface and Subsurface Soil Sampling
- Sediment Sampling
- Surface Water Sampling
- Electromagnetic Conductivity Surveys
- Ground Penetrating Radar
- Classifying Soils and Rocks
- Installation of Monitoring Wells
- Aquifer Testing
- Technical Software and Programs for Use on IBM Personal Computers
- Well Development
- Surface Geophysical Techniques
- Water Level Measurements
- Drilling Methods and Techniques
- Drilling Safety
- Groundwater Sampling
- Geologic Sampling
- Geologic Reporting
- Geologic Logging
- Slug Tests
- Controlled Pumping Tests
- Field Screening

Prior to and during field work, all applicable SOPs will be available in the field for reference.

4.3 SAMPLE COLLECTION

The specific methods for sample container size and type, sample preservation and holding times, and any special handling requirements for samples collected at OU-4 are presented in Tables 4-1, 4-2, and 4-3. All sample containers will be obtained from an approved retail source, or the project laboratory, to assure proper container cleaning and preparation. These containers will be verified as precleaned and will be obtained in sealed boxes.

All samples, including blanks (except trip blanks), will be prepared (placed in containers and sealed) in the field. All sample locations and protocols, as well as all field activities will be recorded in a bound logbook prior to packaging for shipment or transfer to the field laboratory.

Table 4-1 SAMPLE COLLECTION SUMMARY OPERABLE UNIT 4 - LANDFILL FORT WAINWRIGHT FAIRBANKS, ALASKA					
Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time From Sample Collection	QA/QC Samples
SUBSURFACE SOIL					
20	Volatile organic compounds ⁽³⁾	Two 2-oz glass VOA jars with Teflon-lined septa	4°C	14 days	1 Trip blank/shipment 1 Equipment rinsate/day 12 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
20	Semivolatile organic compounds ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day 12 Background samples
To be determined in the field	Benzene, toluene, ethylbenzene, xylene (BTEX), Trichloro-ethene (TCE), field analysis	2-oz glass jar with Teflon-lined lid	4°C	14 days	Field duplicates (1/10) 1 Equipment rinsate/day
20	Target Analyte List (TAL) Metals ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	6 months (28 days Hg)	12 Background samples MS/duplicate samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
20	Pesticides/Polychlorinated biphenyls (PCBs) ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction, 40 days to analysis	12 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day

Table 4-1

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - LANDFILL
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time From Sample Collection	QA/QC Samples
20	Chlorinated Herbicides	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction, 40 days to analysis	12 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
20	Petroleum hydrocarbon classification	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction, 40 days to analysis	12 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
20	Total recoverable petroleum hydrocarbons	8-oz glass jar with Teflon-lined lid	4°C	28 days	12 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
20	Total organic carbon (TOC)	8-oz glass jar with Teflon-lined lid	4°C	28 days	12 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
4	Grain size, Atterberg limits, specific gravity, moisture content	1-quart glass jar with Teflon-lined lid	None	None	None
4	Nitrate/Nitrite	8-oz glass jar with Teflon-lined lid	4°C	48 hours	MS/MSD samples (1/20) Field duplicates (1/10)
4	Phosphorus	8-oz glass jar with Teflon-lined lid	4°C	28 days	MS/MSD samples (1/20) Field duplicates (1/10)
4	Toxic characteristic leaching procedure (TCLP) (archived)	8-oz glass jar with Teflon-lined lid	4°C	Archive	MS/MSD samples (1/20) Field duplicates (1/10)

Table 4-1

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - LANDFILL
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time From Sample Collection	QA/QC Samples
1	Gas-Range organics (VPH-G)	Two 2-oz glass jars with Teflon-lined lids	4°C	14 days	None
1	Diesel-Range organics (DRO)	4-oz glass jar with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	None
SURFACE SOIL					
42	Volatile organic compounds ⁽³⁾	Two 2-oz glass VOA jars with Teflon-lined septa	4°C	14 days	1 Trip blank/shipment 2 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
42	Semivolatile organic compounds ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
To be determined in the field	BTEX (field analysis)	2-oz glass jar with Teflon-lined lid	4°C	14 days	Field duplicates (1/10) Equipment rinsates (1 per day)
42	TAL metals ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	6 months (28 days Hg);	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
42	Pesticides/PCBs ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
42	TOC	8-oz glass jar with Teflon-lined lid	4°C	28 days	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10)

Table 4-1

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - LANDFILL
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time From Sample Collection	QA/QC Samples
4	Nitrate/Nitrite	8-oz glass jar with Teflon-lined lid	4°C	48 hours	MS/MSD samples (1/20) Field duplicates (1/10)
4	Phosphorus	8-oz glass jar with Teflon-lined lid	4°C	28 days	MS/MSD samples (1/20) Field duplicates (1/10)
4	TCLP (archived)	8-oz glass jar with Teflon-lined lid	4°C	Archive	MS/MSD samples (1/20) Field duplicates (1/10)
42	Chlorinated Herbicides	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction, 40 days to analysis	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
42	Total recoverable petroleum hydrocarbons	8-oz glass jar with Teflon-lined lid	4°C	28 days	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
4	Atterberg limits, specific gravity, moisture content, grain size	1-quart glass jar with Teflon-lined lid	None	None	None
42	Petroleum hydrocarbon classification	8-oz glass jar with Teflon-lined lid	4°C	14 days	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
2	VPH-G	Two 2-oz glass jars with Teflon-lined lids	4°C	14 days	None
2	DRO	4-oz glass jar with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	None

Table 4-1

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - LANDFILL
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time From Sample Collection	QA/QC Samples
SEDIMENTS					
24	Volatile organic compounds ⁽³⁾	Two 2-oz glass VOA jars with Teflon-lined septa	4°C	14 days	2 Background sample Field duplicates (1/10) MS/MSD samples (1/20) 1 Trip blank/shipment
24	Semivolatile organic compounds ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	2 Background sample Field duplicates (1/10) MS/MSD samples (1/20)
24	TAL metals ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	6 months (28 days Hg)	2 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
4	Sediment toxicity tests	Two 1-liter polyethylene containers	4°C	7 days	1 Background sample Field duplicates (1/10)
1	Grain size	1-quart glass jar with Teflon-lined lid	None	None	None
24	TOC	8-oz glass jar with Teflon-lined lid	4°C	28 days	2 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
24	Petroleum hydrocarbon classification	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	2 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
24	Total recoverable petroleum hydrocarbons	8-oz glass jar with Teflon-lined lid	4°C	28 days	2 Background samples Field duplicates (1/10) MS/MSD samples (1/20)

Table 4-1

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - LANDFILL
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time From Sample Collection	QA/QC Samples
24	Pesticides/PCBs ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	2 Background sample Field duplicates (1/10) MS/MSD samples (1/20)
24	Chlorinated Herbicides	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction, 40 days to analysis	2 Background sample Field duplicates (1/10) MS/MSD samples (1/20)
2	VPH-G	Two 2-oz glass jars with Teflon-lined lids	4°C	14 days	None
2	DRO	4-oz glass jar with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	None
GROUNDWATER					
21	Volatile organic compounds ⁽³⁾	Two 40-mL glass VOA vials with Teflon-lined septa	HCl to pH < 2 4°C	14 days	1 field blank/day 3 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Trip blank/shipment 1 Equipment rinsate/day
21	Semivolatile organic compounds ⁽³⁾ + Tetrahydrofuran (THF)	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	3 Background samples MS/MSD samples (1/20) 1 Equipment rinsate/day Field duplicates (1/10)
To be determined	BTEX, trichloroethene (TCE) (field analysis)	Two 40-mL glass VOA vials with Teflon-lined lids	4°C	7 days	1 Equipment rinsate/day Field duplicates (1/10)

Table 4-1

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - LANDFILL
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time From Sample Collection	QA/QC Samples
21	Total priority pollutant metals ⁽³⁾ and barium	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2	6 months (28 days Hg)	3 Background samples MS/duplicate samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
21	Dissolved priority pollutant metals and barium	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2 (filtered)	6 months (28 days Hg)	3 Background samples MS/duplicate samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
21	Total dissolved solids (TDS)	1-liter polyethylene bottle with polyethylene-lined lid	4°C	7 days	3 Background samples MS/duplicate samples (1/20) Field duplicates (1/10)
21	TOC	Two 1-liter amber glass bottles with Teflon-lined lids	HCl to pH <2; 4°C	28 days	3 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
21	Petroleum hydrocarbon classification	1-liter glass amber bottle with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	3 Background samples Field duplicates (1/10) MS/MSD samples (1/20) 1 Equipment rinsate/day
21	Total recoverable petroleum hydrocarbons	Two 1-liter glass amber bottles with Teflon-lined lids	HCl to pH <2; 4°C	28 days	3 Background samples Field duplicates (1/10) MS/MSD samples (1/20) 1 Equipment rinsate/day

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Table 4-1

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - LANDFILL
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time From Sample Collection	QA/QC Samples
21	Chlorinated herbicides	Two 1-liter amber bottles with Teflon-lined lids	4°C	7 days to extraction; 40 days to analysis	3 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
21	Explosives residues	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction; 40 days to analysis	3 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
21	Pesticides/PCBs	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction; 40 days to analysis	3 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
1	VPH-G	Three 40-mL glass VOA vials with Teflon-lined septa	HCl to pH <2; 4°C	14 days	None
1	DRO	1-liter amber glass bottle with Teflon-lined lid	HCl to pH <2; 4°C	7 days to extraction 40 days to analysis	None
21	Alkalinity	1-liter polyethylene bottle with polyethylene-lined lid	4°C	14 days	Field duplicates (1/10) 3 Background samples MS/MSD samples (1/20)
21	Major cations ⁽³⁾	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2; 4°C (filtered)	6 months	Field duplicates (1/10) 3 Background samples MS/duplicate samples (1/20)
21	Major anions ⁽³⁾	1-liter polyethylene bottle with polyethylene-lined lid	4°C (filtered)	28 days	Field duplicates (1/10) 3 Background samples MS/duplicate samples (1/20)

Table 4-1

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - LANDFILL
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time From Sample Collection	QA/QC Samples
21	NO ₃ /NO ₂	1-liter polyethylene bottle with polyethylene-lined lid	H ₂ SO ₄ to pH <2; 4°C	28 days	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
21	Biochemical oxygen demand	1-liter polyethylene bottle with polyethylene-lined lid	4°C	48 hours	Field duplicates (1/10) 3 Background samples MS/MSD samples (1/20)
21	Potassium	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2; 4°C	6 months	Field duplicates (1/10) 3 Background samples MS/duplicate samples (1/20)
SURFACE WATER					
14	Volatile organic compounds ⁽³⁾	Two 40-mL glass VOA vials with Teflon-lined septa	HCl to pH <2 4°C	14 days	1 Field blank/day 2 Background samples MS/MSD samples (1/20) 1 Trip blank/shipment Field duplicates (1/10)
14	Semivolatile organic compounds ⁽³⁾	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	2 Background sample MS/MSD samples (1/20) Field duplicates (1/10)
14	Petroleum hydrocarbon classification	1-liter amber glass bottle with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	2 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
14	Total recoverable petroleum hydrocarbons	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	28 days	2 Background samples Field duplicates (1/10) MS/MSD samples (1/20)

Table 4-1
SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - LANDFILL
FORT WAINWRIGHT
FAIRBANKS, ALASKA

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time From Sample Collection	QA/QC Samples
14	TDS	1-liter polyethylene bottle with polyethylene-lined lid	4°C	7 days	2 Background samples MS/duplicate samples (1/20)
14	Total priority pollutant metals ⁽³⁾ and barium	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2	6 months (28 days Hg)	2 Background samples MS/duplicate samples (1/20) Field duplicates (1/10)
14	Nitrate-nitrite	1-liter polyethylene bottle with polyethylene-lined lid	H ₂ SO ₄ to pH <2; 4°C	28 days	2 background samples MS/MSD samples (1/20) Field duplicates (1/10)
14	Dissolved priority pollutants metals and barium	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2 (filtered)	6 months (28 days Hg)	2 Background sample MS/duplicate samples (1/20) Field duplicates (1/10)
14	Pesticides/PCBs ⁽³⁾	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	2 Background sample MS/MSD samples (1/20) Field duplicates (1/10)
14	Alkalinity	1-liter polyethylene bottle with polyethylene-lined lid	4°C	14 days	Field duplicates (1/10) 2 Background sample MS/MSD samples (1/20)
14	Major cations ⁽³⁾	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2; 4°C (filtered)	6 months	Field duplicates (1/10) MS/duplicate samples (1/20) 1 Background sample

Table 4-1

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - LANDFILL
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time From Sample Collection	QA/QC Samples
14	Major anions ⁽³⁾	1-liter polyethylene bottle with polyethylene-lined lid	4°C	28 days	Field duplicates (1/10) MS/duplicate samples (1/20) 1 Background sample
14	Chlorinated Herbicides	Two 1-liter amber bottles with Teflon-lined lids	4°C	7 days to extraction, 40 days to analysis	Field duplicates (1/10) 2 Background samples MS/MSD samples (1/20)
1	VPH-G	Three 40-mL glass VOA vials with Teflon-lined septa	HCl to pH <2; 4°C	14 days	None
1	DRO	1-liter amber glass bottle with Teflon-lined lid	HCl to pH <2; 4°C	7 days to extraction 40 days to analysis	None
AIR					
15	TAL metals	Filter placed in plastic bag or folder	None	6 months (28 days Hg)	6 Background samples 6 Field duplicates
ASH					
8	TAL metals	8-oz glass jar with Teflon-lined lid	4°C	6 months (28 days Hg)	MS/duplicate samples (1/20) Field duplicates (1/10)
8	Dioxin ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	MS/MSD samples (1/20) Field duplicates (1/10)
8	Semivolatile organic compounds	8-oz glass jar with Teflon-lined lid	4°C	7 days to extraction; 40 days to analysis	Field duplicates (1/10) MS/MSD samples (1/20)

Table 4-1
SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - LANDFILL
FORT WAINWRIGHT
FAIRBANKS, ALASKA

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time From Sample Collection	QA/QC Samples
8	Pesticides/PCBs	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction; 40 days to analysis	Field duplicates (1/10) MS/MSD samples (1/20)
8	Chlorinated Herbicides	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction; 40 days to analysis	MS/MSD samples (1/20) Field duplicates (1/10)
4	Grain size	8-oz glass jar with Teflon-lined lid	N/A	N/A	None

(1) - Actual number of samples to be determined in the field.

(2) - Sample containers will be precleaned by the laboratory or an approved retail source.

(3) - For complete list of analytes and detection limits refer to Attachment 1.

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Table 4-2

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - POWER PLANT COAL STORAGE YARD
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
SUBSURFACE SOIL					
14	Volatile organic compounds ⁽³⁾	Two 2-oz glass volatile organic analyte (VOA) jars with Teflon-lined septa	4°C	14 days	1 Trip blank/shipment 1 Equipment rinsate/day 2 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
14	Semivolatile organic compounds ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day 2 Background samples
To be determined in the field	Benzene, toluene, ethylbenzene, xylene (BTEX), field analysis	8-oz glass jar with Teflon-lined lid	4°C	14 days	Field duplicates (1/10) 1 Equipment rinsate/day
14	Total Recoverable Petroleum Hydrocarbons	8-oz glass jar with Teflon-lined lid	4°C	28 days	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
14	Petroleum hydrocarbon classification	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
14	Target Analyte List (TAL) Metals ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	6 months (28 days Hg)	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
1	Gas-Range Organics (VPH-G)	Two 2-oz glass jars with Teflon-lined septa	4°C	14 days	None

Table 4-2
SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - POWER PLANT COAL STORAGE YARD
FORT WAINWRIGHT
FAIRBANKS, ALASKA

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
1	Diesel-Range Organics (DRO)	4-oz glass jar with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	None
14	Pesticides/Polychlorinated biphenyls (PCBs) ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction, 40 days to analysis	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
14	Total organic carbon (TOC)	8-oz glass jar with Teflon-lined lid	4°C	6 months	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
4	Grain size, Atterberg limits, specific gravity, moisture content	1-quart glass jar with Teflon-lined lid	None	None	None
14	Dioxin	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	2 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
4	Nitrate/Nitrite	8-oz glass jar with Teflon-lined lid	4°C	48 hours	MS/MSD samples (1/20) Field duplicates (1/10)
14	Chlorinated Herbicides	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
4	Phosphorus	8-oz glass jar with Teflon-lined lid	4°C	28 days	MS/MSD samples (1/20) Field duplicates (1/10)

Table 4-2

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - POWER PLANT COAL STORAGE YARD
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
SURFACE SOIL					
5	Volatile organic compounds ⁽³⁾	Two 2-oz glass VOA vials with Teflon-lined septa	4°C	14 days	1 Trip blank/shipment 1 Background sample Field duplicates (1/10) MS/MSD samples (1/20)
5	Semivolatile organic compounds ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10)
5	Petroleum hydrocarbon classification	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10)
5	Total Recoverable Petroleum Hydrocarbons	8-oz glass jar with Teflon-lined lid	4°C	28 days	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10)
To be determined in the field	BTEX (field analysis)	8-oz glass jar with Teflon-lined lid	4°C	7 days	Field duplicates (1/10)
5	Pesticides/PCBs ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10)
5	TAL metals ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	6 months (28 days Hg);	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10)
1	VPH-G	Two 2-oz glass jars with Teflon-lined septa	4°C	14 days	None

Table 4-2
SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - POWER PLANT COAL STORAGE YARD
FORT WAINWRIGHT
FAIRBANKS, ALASKA

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
1	DRO	4-oz glass jar with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	None
5	Chlorinated Herbicides	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
5	TOC	8-oz glass jar with Teflon-lined lid	4°C	28 days	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10)
5	Dioxin ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction, 40 days to analysis	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10)
4	Nitrate/Nitrite	8-oz glass jar with Teflon-lined lid	4°C	48 hours	MS/MSD samples (1/20) Field duplicates (1/10)
4	Phosphorus	8-oz glass jar with Teflon-lined lid	4°C	28 days	MS/MSD samples (1/20) Field duplicates (1/10)
4	Atterberg limits, specific gravity, moisture content, grain size	1-quart glass jar with Teflon-lined lid	None	None	None
SEDIMENTS					
9	Volatile organic compounds ⁽³⁾	Two 2-oz glass VOA vials with Teflon-lined septa	4°C	14 days	1 Background sample Field duplicates (1/10) MS/MSD samples (1/20)

Table 4-2
SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - POWER PLANT COAL STORAGE YARD
FORT WAINWRIGHT
FAIRBANKS, ALASKA

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
9	Semivolatile organic compounds ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction, 40 days to analysis	1 Background sample Field duplicates (1/10) MS/MSD samples (1/20)
9	TAL metals ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	6 months (28 days Hg)	1 Background sample Field duplicates (1/10) MS/MSD samples (1/20)
9	Dioxin ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	1 Background sample Field duplicates (1/10) MS/MSD samples (1/20)
9	Petroleum hydrocarbon classification	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	1 Background sample Field duplicates (1/10) MS/MSD samples (1/20)
9	Total Recoverable Petroleum Hydrocarbons	8-oz glass jar with Teflon-lined lid	4°C	28 days	1 Background sample Field duplicates (1/10) MS/MSD samples (1/20)
9	TOC	8-oz glass jar with Teflon-lined lid	4°C	28 days	1 Background sample Field duplicates (1/10) MS/MSD samples (1/20)
9	Pesticides/PCBs ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	1 Background sample Field duplicates (1/10) MS/MSD samples (1/20)
9	Chlorinated Herbicides	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	1 Background sample Field duplicates (1/10) MS/MSD samples (1/20)

Table 4-2

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - POWER PLANT COAL STORAGE YARD
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
1	VPH-G	Two 2-oz glass jars with Teflon-lined septa	4°C	14 days	None
1	DRO	4-oz glass jar with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	None
GROUNDWATER/SUPPLY WELL WATER					
To be determined in the field	BTEX, TCE, (field analysis)	Two 40-mL VOA vials with Teflon-lined septa	4°C	7 days	Field duplicates (1/10) Equipment rinsates (1/10)
22	Volatile organic compounds ⁽³⁾	Two 40-mL glass VOA vials with Teflon-lined septa ⁽⁴⁾	HCl to pH <2 4°C	14 days	1 field blank/day 1 Background sample MS/MSD samples (1/20) Field duplicates (1/10) 1 Trip blank/shipment 1 Equipment rinsate/day
22	Semivolatile organic compounds ⁽³⁾	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	1 Background sample MS/MSD samples (1/20) 1 Equipment rinsate/day Field duplicates (1/10)
22	Petroleum hydrocarbon classification	1-liter amber glass bottle with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	1 Background sample MS/MSD samples (1/20) 1 Equipment rinsate/day Field duplicates (1/10)
22	Total recoverable petroleum hydrocarbons	Two 1-liter amber glass bottles with Teflon-lined lids	HCl to pH <2; 4°C	28 days	1 Background sample MS/MSD samples (1/20) 1 Equipment rinsate/day Field duplicates (1/10)

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Table 4-2

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - POWER PLANT COAL STORAGE YARD
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
22	Pesticides/PCBs ⁽³⁾	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
22	Chlorinated Herbicides	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
22	Dioxin ⁽³⁾	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
2	VPH-G	Three 40-mL VOA vials with Teflon-lined septa	HCl to pH <2; 4°C	14 days	None
2	DRO	1-liter amber glass bottle with Teflon-lined lid	HCl to pH <2; 4°C	7 days to extraction 40 days to analysis	None
22	Total priority pollutant metals ⁽³⁾ and barium	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2	6 months (28 days Hg)	1 Background sample MS/duplicate samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
22	Dissolved priority pollutant metals and barium	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2 (filtered)	6 months (28 days Hg)	1 Background sample MS/duplicate samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day

Table 4-2

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - POWER PLANT COAL STORAGE YARD
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
22	Total dissolved solids	1-liter polyethylene bottle with polyethylene-lined lid	4°C	7 days	1 Background sample MS/duplicate samples (1/20) Field duplicates (1/10)
22	TOC	Two 1-liter amber glass bottles with Teflon-lined lids	HCl to pH <2; 4°C	28 days	1 Background sample Field duplicates (1/10) MS/MSD samples (1/20)
22	Alkalinity	1-liter polyethylene bottle with polyethylene-lined lid	4°C	14 days	Field duplicates (1/10) 1 Background sample MS/MSD samples (1/20)
22	Major cations ⁽³⁾	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2; 4°C (filtered)	6 months	Field duplicates (1/10) 1 Background sample MS/duplicate samples (1/20)
22	Major anions ⁽³⁾	1-liter polyethylene bottle with polyethylene-lined lid	4°C (filtered)	28 days	Field duplicates (1/10) 1 Background sample MS/duplicate samples (1/20)
22	Nitrate/Nitrite	500-mL brown polyethylene bottle with polyethylene-lined lids; field rinsed	maintain at 4°C	24 hours	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10)
22	Biochemical oxygen demand	1-liter polyethylene bottle with polyethylene-lined lid	4°C	48 hours	Field duplicates (1/10) 1 Background sample MS/MSD samples (1/20)

Table 4-2

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - POWER PLANT COAL STORAGE YARD
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
22	Potassium	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2; 4°C	6 months	Field duplicates (1/10) 1 Background sample MS/MSD samples (1/20)
SURFACE WATER					
7	Volatile organic compounds ⁽³⁾	Two 40-mL glass VOA vials with Teflon-lined septa	HCl to pH <2 4°C	14 days	1 Background sample 1 Field blank/day MS/MSD samples (1/20) 1 Trip blank/shipment Field duplicates (1/10)
7	Semivolatile organic compounds ⁽³⁾	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10)
7	Petroleum hydrocarbon classification	1-liter amber glass bottle with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10)
1	VPH-G	Three 40-mL VOA vials with Teflon-lined septa	HCl to pH <2; 4°C	14 days	None
1	DRO	1-liter amber glass bottle with Teflon-lined lid	HCl to pH <2; 4°C	7 days to extraction 40 days to analysis	None
7	Total recoverable petroleum hydrocarbons	Two 1-liter amber glass bottles with Teflon-lined lids	HCl to pH <2 4°C	28 days	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10)
7	Pesticides/PCBs ⁽³⁾	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10)

Table 4-2

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - POWER PLANT COAL STORAGE YARD
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
7	Chlorinated Herbicides	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10)
7	Dioxin ⁽³⁾	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	1 Background sample MS/MSD samples (1/20) Field duplicates (1/10)
7	Total dissolved solids (TDS)	1-liter polyethylene bottle with polyethylene-lined lid	4°C	7 days	1 Background sample Lab duplicate samples (1/20)
7	Total priority pollutant metals ⁽³⁾ and barium	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2	6 months (28 days Hg)	1 Background sample MS/duplicate samples (1/20) Field duplicates (1/10)
7	Dissolved priority pollutants metals and barium	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2 (filtered)	6 months (28 days Hg)	1 Background sample MS/duplicate samples (1/20) Field duplicates (1/10)
7	Alkalinity	1-liter polyethylene bottle with polyethylene-lined lid	4°C	14 days	1 Background sample Field duplicates (1/10) MS/MSD samples (1/20)
7	Major cations ⁽³⁾	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2; 4°C (filtered)	6 months	1 Background sample MS/duplicate samples (1/20) Field duplicates (1/10)

Table 4-2 SAMPLE COLLECTION SUMMARY OPERABLE UNIT 4 - POWER PLANT COAL STORAGE YARD FORT WAINWRIGHT FAIRBANKS, ALASKA					
Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
7	Major anions ⁽³⁾	1-liter polyethylene bottle with polyethylene-lined lid	4°C	28 days	1 Background sample MS/duplicate samples (1/20) Field duplicates (1/10)

- (1) - Actual number of samples to be determined in the field.
- (2) - Sample containers will be precleaned by the laboratory at an approved retail source.
- (3) - For complete list of analytes and detection limits refer to Attachment 1.
- (4) - Three 40-mL VOA vials with Teflon-lined lids are needed for Method 524.

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Table 4-3
SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - FIRE TRAINING PITS
FORT WAINWRIGHT
FAIRBANKS, ALASKA

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
SUBSURFACE SOIL					
38	Volatile organic compounds ⁽³⁾	Two 2-oz glass VOA jars with Teflon-lined septa	4°C	14 days	1 Trip blank/shipment 1 Equipment rinsate/day 2 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
38	Semivolatile organic compounds ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day 2 Background samples
To be determined in the field	Benzene, toluene, ethylbenzene, xylene (BTEX), field analysis	8-oz glass jar with Teflon-lined lid	4°C	14 days	Field duplicates (1/10) 1 Equipment rinsate/day
38	Total Recoverable Petroleum Hydrocarbons	8-oz glass jar with Teflon-lined lid	4°C	28 days	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
38	Petroleum hydrocarbon classification	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
38	Target Analyte List (TAL) Metals ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	6 months (28 days Hg)	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
2	Gas-Range Organics (VPH-G)	Two 2-oz glass jars with Teflon-lined lids	4°C	14 days	None

Table 4-3

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - FIRE TRAINING PITS
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
2	Diesel-Range Organics (DRO)	4-oz glass jar with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	None
38	Pesticides/PCBs ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction, 40 days to analysis	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
38	Chlorinated Herbicides	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction, 40 days to analysis	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
38	Dioxin ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction, 40 days to analysis	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
38	Total organic carbon (TOC)	8-oz glass jar with Teflon-lined lid	4°C	6 months	2 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
4	Grain size, Atterberg limits, specific gravity, moisture content	1-quart glass jar with Teflon-lined lid	None	None	None
4	Nitrate/Nitrite	8-oz glass jar with Teflon-lined lid	4°C	48 hours	MS/MSD samples (1/20) Field duplicates (1/10)
4	Phosphorus	8-oz glass jar with Teflon-lined lid	4°C	28 days	MS/MSD samples (1/20) Field duplicates (1/10)

Table 4-3
SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - FIRE TRAINING PITS
FORT WAINWRIGHT
FAIRBANKS, ALASKA

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
SURFACE SOIL					
53	Volatile organic compounds ⁽³⁾	Two 2-oz glass VOA vials with Teflon-lined septa	4°C	14 days	1 Trip blank/shipment 3 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
53	Semivolatile organic compounds ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
53	Petroleum hydrocarbon classification	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
3	VPH-G	Two 2-oz glass vials with Teflon-lined septa	4°C	14 days	None
3	DRO	4-oz glass jar with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	None
53	Total Recoverable Petroleum Hydrocarbons	8-oz glass jar with Teflon-lined lid	4°C	28 days	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
To be determined in the field	BTEX (field analysis)	8-oz glass jar with Teflon-lined lid	4°C	14 days	Field duplicates (1/10) 1 Equipment rinsate/day
53	Pesticides/PCBs ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)

Table 4-3

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - FIRE TRAINING PITS
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
53	Dioxin ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
53	Chlorinated Herbicides	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction, 40 days to analysis	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
53	TAL metals ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	6 months (28 days Hg)	3 Background samples MS/duplicate samples (1/20) Field duplicates (1/10)
53	TOC	8-oz glass jar with Teflon-lined lid	4°C	28 days	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
4	Nitrate/Nitrite	8-oz glass jar with Teflon-lined lid	4°C	48 hours	MS/MSD samples (1/20) Field duplicates (1/10)
4	Phosphorus	8-oz glass jar with Teflon-lined lid	4°C	28 days	None
4	Atterberg limits, specific gravity, moisture content, grain size	1-quart glass jar with Teflon-lined lid	None	None	None
SEDIMENTS					
12	Volatile organic compounds ⁽³⁾	Two 2-oz glass VOA jars with Teflon-lined septa	4°C	14 days	3 Background samples Field duplicates (1/10) MS/MSD samples (1/20) 1 Trip blank/shipment

Table 4-3
SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - FIRE TRAINING PITS
FORT WAINWRIGHT
FAIRBANKS, ALASKA

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
12	Semivolatile organic compounds ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction, 40 days to analysis	3 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
12	TAL metals ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	6 months (28 days Hg)	3 Background sample Field duplicates (1/10) MS/MSD samples (1/20)
12	Petroleum hydrocarbon classification	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction, 40 days to analysis	3 Background sample Field duplicates (1/10) MS/MSD samples (1/20)
1	VPH-G	Two 2-oz glass vials with Teflon-lined septa	4°C	14 days	None
1	DRO	4-oz glass jar with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	None
12	Total Recoverable Petroleum Hydrocarbons	8-oz glass jar with Teflon-lined lid	4°C	28 days	3 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
12	TOC	8-oz glass jar with Teflon-lined lid	4°C	28 days	3 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
12	Pesticides/PCBs ⁽³⁾	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	3 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
12	Chlorinated Herbicides	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction, 40 days to analysis	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)

Table 4-3

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - FIRE TRAINING PITs
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
12	Dioxin	8-oz glass jar with Teflon-lined lid	4°C	14 days to extraction 40 days to analysis	3 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
GROUNDWATER					
To be determined in the field	BTEX, trichloroethene (field analysis)	Two 40-mL glass VOA vials with Teflon-lined septa	4°C	7 days	1 Equipment rinsate/day Field duplicates (1/10)
12	Volatile organic compounds ⁽³⁾	Two 40-mL glass VOA vials with Teflon-lined septa	HCl to pH < 2 4°C	14 days	1 Field blank/day 3 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Trip blank/shipment 1 Equipment rinsate/day
12	Semivolatile organic compounds ⁽³⁾	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	3 Background samples MS/MSD samples (1/20) 1 Equipment rinsate/day Field duplicates (1/10)
12	Petroleum hydrocarbon classification	1-liter amber glass bottle with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	3 Background samples MS/MSD samples (1/20) 1 Equipment rinsate/day Field duplicates (1/10)
1	VPH-G	Three 40-mL glass VOA vials with Teflon-lined septa	HCl to pH < 2; 4°C	14 days	None
1	DRO	1-liter amber glass bottle with Teflon-lined lid	HCl to pH < 2; 4°C	7 days to extraction 40 days to analysis	None

Table 4-3

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - FIRE TRAINING PITS
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
12	Total recoverable petroleum hydrocarbons	Two 1-liter amber glass bottles with Teflon-lined lids	HCl to pH <2; 4°C	28 days	3 Background samples MS/MSD samples (1/20) 1 Equipment rinsate/day Field duplicates (1/10)
12	Pesticides/PCBs ⁽³⁾	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
12	Chlorinated Herbicides	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	14 days to extraction, 40 days to analysis	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
12	Dioxin ⁽³⁾	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10) 1 Equipment rinsate/day
12	Total priority pollutant metals ⁽³⁾ and barium	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2	6 months (28 days Hg)	3 Background samples MS/duplicate samples (1/20) Field duplicates (1/10) 2 Equipment rinsate/day
12	Dissolved priority pollutant metals and barium	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2 (filtered)	6 months (28 days Hg)	3 Background samples Lab duplicate samples (1/20) Field duplicates (1/10)

Table 4-3

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - FIRE TRAINING PITS
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
12	Total dissolved solids	1-liter polyethylene bottle with polyethylene-lined lid	4°C	7 days	3 Background samples Lab duplicate samples (1/20) Field duplicates (1/10)
12	TOC	Two 1-liter amber glass bottles with Teflon-lined lids	HCl to pH <2; 4°C	28 days	3 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
12	Alkalinity	1-liter polyethylene bottle with polyethylene-lined lid	4°C	14 days	Field duplicates (1/10) 3 Background samples MS/MSD samples (1/20)
12	Major cations ⁽³⁾	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2; 4°C (filtered)	6 months	Field duplicates (1/10) 3 Background samples MS/MSD samples (1/20)
12	Major anions ⁽³⁾	1-liter polyethylene bottle with polyethylene-lined lid	4°C (filtered)	28 days	Field duplicates (1/10) 3 Background samples MS/MSD samples (1/20)
12	Nitrate/Nitrite	500-mL brown polyethylene bottle with polyethylene-lined lids	maintain at 4°C	24 hours	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
12	Biochemical oxygen demand	1-liter polyethylene bottle with polyethylene-lined lid	4°C	48 hours	3 Background samples Field duplicates (1/10) MS/MSD samples (1/20)
12	Potassium	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH <2; 4°C	6 months	3 Background samples Field duplicates (1/10) MS/MSD samples (1/20)

Table 4-3

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - FIRE TRAINING PITS
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
SURFACE WATER					
12	Volatile organic compounds ⁽³⁾	Two 40-mL glass VOA vials with Teflon-lined septa	HCl to pH <2 4°C	14 days	1 Field blank/day 3 Background samples MS/MSD samples (1/20) 1 Trip blank/shipment Field duplicates (1/10)
12	Semivolatile organic compounds ⁽³⁾	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
12	Petroleum hydrocarbon classification	1-liter amber glass bottle with Teflon-lined lid	4°C	7 days to extraction 40 days to analysis	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
1	VPH-G	Three 40-mL glass VOA vials with Teflon-lined septa	HCl to pH <2; 4°C	14 days	None
1	DRO	1-liter amber glass bottle with Teflon-lined lid	HCl to pH <2; 4°C	7 days to extraction 40 days to analysis	None
12	Total recoverable petroleum hydrocarbons	Two 1-liter amber glass bottles with Teflon-lined lids	HCl to pH <2 4°C	28 days	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
12	Pesticides/PCBs ⁽³⁾	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)

Table 4-3

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - FIRE TRAINING PITS
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples ⁽¹⁾	Analytical Parameter	Type of Sample Container ⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
12	Chlorinated Herbicides	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	14 days to extraction, 40 days to analysis	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
12	Dioxin ⁽³⁾	Two 1-liter amber glass bottles with Teflon-lined lids	4°C	7 days to extraction 40 days to analysis	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
12	Total dissolved solids (TDS)	1-liter polyethylene bottle with polyethylene-lined lid	4°C	7 days	3 Background samples Lab duplicate samples (1/20)
12	Total priority pollutant metals ⁽³⁾ and barium	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2	6 months (28 days Hg)	3 Background samples MS/duplicate samples (1/20) Field duplicates (1/10)
12	Dissolved priority pollutants metals ⁽³⁾ and barium	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2 (filtered)	6 months (28 days Hg)	3 Background samples MS/duplicate samples (1/20) Field duplicates (1/10)
12	Alkalinity	1-liter polyethylene bottle with polyethylene-lined lid	4°C	14 days	3 Background samples MS/MSD samples (1/20) Field duplicates (1/10)
12	Major cations ⁽³⁾	1-liter polyethylene bottle with polyethylene-lined lid	HNO ₃ to pH < 2; 4°C (filtered)	6 months	MS/duplicate samples (1/20) 2 Background sample Field duplicates (1/10)

Table 4-3

**SAMPLE COLLECTION SUMMARY
OPERABLE UNIT 4 - FIRE TRAINING PITS
FORT WAINWRIGHT
FAIRBANKS, ALASKA**

Number of Project Samples⁽¹⁾	Analytical Parameter	Type of Sample Container⁽²⁾	Sample Preservation	Technical Holding Time	QA/QC Samples
12	Major anions ⁽³⁾	1-liter polyethylene bottle with polyethylene-lined lid	4°C	28 days	MS/duplicate samples (1/20) Field duplicates (1/10) 3 Background samples

- (1) - Actual number of samples to be determined in the field.
- (2) - Sample containers will be precleaned by the laboratory or an approved retail source.
- (3) - For complete list of analytes and detection limits refer to Attachment 1.

5. SAMPLE CUSTODY

This section addresses procedures that will be used to identify samples and document the samples' chain-of-custody at the OU-4 site. These procedures are necessary to ensure that the quality of the samples is maintained during their collection, transportation, storage, and analysis. All sample control and chain-of-custody procedures will follow the CLP User's Guide (EPA 1988). Procedures for custody, documentation, handling, packaging, and shipping environmental samples are described below.

5.1 CHAIN-OF-CUSTODY

The primary objective of the chain-of-custody procedures is to provide an accurate written or computerized record that can be used to trace the possession and handling of a sample from collection to completion of all required analyses. A sample is in custody if it is:

- In someone's physical possession;
- In someone's view;
- Locked up; or
- Kept in a secured area that is restricted to authorized personnel.

5.1.1 Field Custody Procedures

To protect sample integrity in the field, the following procedures will be followed.

- Sample bottles will be obtained precleaned from the laboratory performing the analyses or an approved retail source. Coolers or boxes containing cleaned bottles will be sealed with a custody tape seal during transport to the field or while in storage prior to use.
- The sample collector will record sample data in the field notebook.

- The sample collector will be personally responsible for the care and custody of samples collected until they are transferred to another person or dispatched properly under chain-of-custody rules.
- As few persons as possible will handle samples.
- The project manager will be responsible for oversight of proper custody procedures during the fieldwork.

5.1.2 Sample Shipping Log Sheet

A shipping log sheet will be prepared for each sampling event at OU-4. The sample shipping log sheet will include sample number, sampling date, sample description, date shipped, bill of lading or Federal Express number, matrix, preservative, laboratory shipped to, and analyses to be performed. It will also be used to verify receipt of a complete data package from the laboratory and provide data reviewers with necessary information about field blanks, duplicates, etc. The shipping log sheet is part of the evidentiary record and will be completed by field personnel.

5.1.3 Chain-of-Custody Record

The chain-of-custody record will be completed in duplicate, at a minimum, by the field technician who is designated by the site manager as responsible for sample shipment to the appropriate laboratory for analysis. The chain-of-custody record includes project number, samplers' signatures, date and time of sample collection, and sample location.

5.1.4 Transfer of Custody and Shipment

Procedures for transfer of custody and shipments are identified below.

- The coolers in which the samples are packed must be accompanied by the chain-of-custody record. When transferring samples, the individuals relinquishing and receiving them must sign, date, and note the time on the chain-of-custody record. This record documents sample custody transfer.
- Samples must be dispatched to the laboratory for analysis with separate chain-of-custody records accompanying each cooler. Shipping containers must be sealed with custody seals for shipment to the laboratory. The method of shipment, name of courier, and other pertinent information must be entered in the chain-of-custody record.
- Samples will be dispatched to the laboratory via overnight express.

- All shipments must be accompanied by the chain-of-custody record identifying their contents. The original record accompanies the shipment. The other copies are distributed appropriately to the site team leader and project manager.
- When sent by common carrier, a bill of lading is used. Freight bills, Postal Service receipts, and bills of lading are retained as part of the permanent documentation.

5.2 DOCUMENTATION

The following sections describe documentation procedures to be followed for sample identification, daily logs, corrections to documentation, and photographs.

5.2.1 Sample Identification

All containers of samples collected will be identified using a 9 to 12 digit alphanumeric code on a label or tag fixed to the sample container. The alphanumeric code will be assigned to each sample as an identification number to track samples collected at the site. The sample code for project laboratory samples is broken down as follows.

Group	Digits	Description	Code Examples
(1)	1-2	Calendar Year	92, 93
(2)	3-7	IRP identifying code	LF (Landfill), FTP (Fire Training Pits, PPCSY (Power Plant Coal Storage Yard)
(3)	8-10	Sample number	010, 110
(4)	11-12	<u>Sample type</u>	<u>Symbol</u>
		Sediment	SD
		Surface Water	SW
		Groundwater	GW
		Ash	AS
		Surface Soil	SS
		Subsurface Soil	SB
		Air	AR

Example: 92 LF 010 SS = 1992, Landfill, Sample No. 10, Surface Soil

Each sample will be chemically preserved, if required, and the sample container will be labeled and sealed immediately after collection. To minimize handling of sample containers, labels will be filled out prior to sample collection. The sample label will be filled out using

waterproof ink and will be firmly affixed to the sample container and protected with Mylar tape.
The sample label will include the following information:

- Initials of sampler,
- Date and time of collection,
- Sample number,
- Analysis required,
- pH, and
- Preservation.

Samples collected for field laboratory analysis will be assigned an identification number using the following format.

Group	Digits	Description	Code Examples
(1)	1-2	Field laboratory designation	FL*
(2)	3-4	<u>Sample type</u> Surface soil Subsurface soil Groundwater	<u>Symbol</u> SS SB GW
(3)	5-8	Area identifying number and sample number 1000 series Landfill 2000 series Coal Storage Yard 3000 series Fire Training Pits	1001

Example: FL-SB-3003 - A field laboratory subsurface soil sample from the Fire Training Pits; the third sample collected for field analysis from this area.

* FL will be a constant.

A field laboratory sample that is sent to the project laboratory for analysis will be re-assigned an 9 to 12 digit number as described above, prior to shipment.

5.2.2 Daily Logs

Daily logs and data forms are necessary to document sufficient data and observations to enable participants to reconstruct events that occurred during the project and to refresh the memory of field personnel if called upon to give testimony during legal proceedings. All daily logs will be kept in a bound, waterproof notebook containing numbered pages. All entries will be made in waterproof ink, dated, and signed. No pages will be removed for any reason. Corrections will be made according to the procedures in Section 5.2.3.

The daily Site Log will be the responsibility of the site team leader and will include a complete summary of the day's activities at the site. The log will include:

- Name of the person making entry (signature).
- Names of team members on-site.
- Levels of personnel protection:
 - Level of protection originally used;
 - Changes in protection, if required; and
 - Reason for changes.
- Daily site safety meeting.
- Time spent collecting samples.
- Documentation on samples taken, including:
 - Sampling date;
 - Sampling location and depth station numbers;
 - Sampling personnel;
 - Type of sample (grab, composite, etc.); and
 - Sample matrix.
- On-site measurement data.
- Field observations and remarks.
- Weather conditions, wind directions, etc.
- Unusual circumstances or difficulties.
- Initials of person recording the information.

5.2.3 Corrections to Documentation

Notebook. As with any data logbooks, no pages will be removed for any reason. If corrections are necessary, they must be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside. The correction must be initialed and dated. Some corrected errors will require a footnote explaining the correction.

Sampling Forms. As previously stated, chain-of-custody records, and other forms must be written in waterproof ink. None of these documents are to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on a document assigned to one individual, that individual may make corrections simply by crossing a line through the error and entering the corrected information. The incorrect information should not be obliterated. An subsequent error discovered on a document should be corrected by the person who made the entry. All corrections must be initialed and dated.

5.2.4 Photographs

Photographs will be taken as directed by the project manager. Documentation of a photograph is crucial to its validity as a representation of an existing situation. The following information will be noted in the task log concerning photographs:

- Date, time, and location photograph was taken;
- Photographer (signature);
- Weather conditions;
- Description of photograph taken;
- Reasons why photograph was taken;
- Sequential number of the photograph and the film roll number; and
- Camera and lens system used.

After the photographs have been developed, the information recorded in the field notebook will be transferred to the back of the photographs.

5.3 SAMPLE HANDLING, PACKAGING, AND SHIPPING

The transportation and handling of samples must be accomplished in a manner that not only protects the integrity of the sample, but also prevents any detrimental effects to sample handlers due to the possible hazardous nature of samples. Regulations for packaging, marking, labelling, and shipping hazardous materials are promulgated by United States Department of Transportation (DOT) in the Code of Federal Regulations, 49 CFR 171 through 177 and/or the International Air Transport Association regulations for Dangerous Goods.

5.3.1 Sample Packaging

Samples must be packaged carefully to avoid breakage or contamination and must be shipped to the laboratory at proper temperatures. The following sample package requirements will be followed:

- Sample bottle lids must never be mixed. All sample lids must stay with the original containers.
- The sample volume level can be marked by placing the tip of the label at the appropriate sample height, or by using a grease pencil. This procedure will help the laboratory to determine if any leakage occurred during shipment. The label should not cover any bottle preparation QA/QC lot numbers.
- All sample bottles will be placed in a plastic bag to minimize leakage in the event a bottle breaks during shipment.
- The environmental samples will be cooled. The use of ice sealed in plastic bags is preferred over artificial icing materials. Ice is not to be used as a substitute for packing materials.
- Any remaining space in the cooler should be filled with inert packing material. Under no circumstances should material such as sawdust, newspaper, sand, etc., be used.
- The custody record must be placed in a plastic bag and taped to the bottom of the cooler lid. Custody seals must be affixed to the sample cooler.

5.3.2 Shipping Containers

Shipping containers are to be custody-sealed for shipment as appropriate. The container closure will consist of filament tape wrapped around the package at least twice in two separate places and custody seals affixed in such a way that access to the container can be gained only by cutting the filament tape and breaking a seal.

Field personnel will make arrangements for transportation of samples to the laboratory. When custody is relinquished to a shipper, field personnel will telephone the laboratory sample custodian to inform him/her of the expected time of arrival of the sample shipment and to advise him/her of any time constraints on sample analysis.

5.3.3 Marking and Labeling

The marking and labeling for shipping containers should follow the guidance presented below.

- Use abbreviations only where specified.
- The words "This End Up" or "This Side Up" must be clearly printed on the top of the outer package. Upward pointing arrows should be placed on the sides of the package. The words "Laboratory Samples" should also be printed on the top of the package.
- After a shipping container has been sealed, two chain-of-custody seals are placed on the container, one on the front and one on the back. The seals are protected from accidental damage by placing mylar tape over them.
- If samples are designated as medium or high hazard, they must be sealed in metal paint cans, placed in the cooler with vermiculite and labeled and placarded in accordance with DOT regulations.
- In addition, the coolers must be labeled and placarded in accordance with DOT regulations if shipping medium and high hazard samples.

5.3.4 Field Analysis Custody Procedures

Samples collected for on-site analysis also will be maintained under chain-of-custody procedures. A chain-of-custody record will be completed prior to submission of samples to the field analytical laboratory. The samples will be received directly from field personnel by the project chemist. Samples collected for field analysis will be stored in a designated secure area. Unauthorized personnel will be prevented from entering the field laboratory. The laboratory will be locked during non-work hours.

6. CALIBRATION PROCEDURES

All instruments and equipment used during sampling and analysis will be operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations and SOPs, as well as criteria set forth in the applicable analytical methodology reference. Operation, calibration, and maintenance will be performed by personnel properly trained in these procedures. Documentation of all routine and special maintenance and calibration information will be maintained in an appropriate logbook or reference file, and will be available on request.

Brief descriptions of calibration procedures for applicable field and laboratory instruments will be provided by the project laboratory and selected contractor prior to the initiation of field investigation activities.

7. ANALYTICAL PROCEDURES

The analytical methodologies to be used for generation of field analytical data (pH, temperature, conductivity, redox potential, dissolved oxygen, and extractable petroleum hydrocarbons) at OU-4 are summarized in Table 7-1. Field analytical data will be used to augment information generated through laboratory analysis and will aid in determining optimum soil sampling locations for collection of samples for laboratory analysis, and delineating the contaminant plume during field investigations. Equipment for monitoring groundwater conditions during well development and purging prior to sampling will meet the specifications of methods specified in Table 7-1.

ADCOE will designate the lead project laboratory for this project. The laboratory will be responsible for custody procedures once samples are received at the laboratory.

Table 7-2 summarizes the methodologies to be used for sample analysis by the project laboratory. Method-related QA/QC requirements are the responsibility of the project laboratory and should be performed in accordance with the method requirement listed in Table 7-2.

Table 7-1				
FIELD ANALYTICAL MEASUREMENTS				
Parameter	Matrix	Method Reference	Method Number	Brief Description of Apparatus
pH	Water	SW-846 ⁽¹⁾	9040	Glass electrode pH meter
Temperature	Water	Standard Methods ⁽²⁾	2550	Thermometer/ Thermistor
Conductivity	Water	SW-846 ⁽¹⁾	9050	Self-Contained Conductivity Meter
Redox Potential	Water	ASTM ⁽³⁾	D-1498-76	Modified pH Meter
Dissolved Oxygen	Water	EPA ⁽⁴⁾	360.1	Membrane Electrode
Benzene, toluene, ethylbenzene, xylene Trichloroethene	Soil, Water	According to instrument manufacturer's instructions	SOP ⁽⁵⁾	Purge and trap; Gas chromatograph with Argon ionization detector

- (1) - "USEPA Test Method for Evaluating Solid Wastes," SW-846, Revision No. 2, September 1986.
- (2) - "Standard Methods for the Examination of Water and Wastewater," 17th edition 1989.
- (3) - "Annual Book of ASTM Standards," American Society for Testing and Materials, Vol. 11.01, 1988.
- (4) - "EPA Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, revised March 1983.
- (5) - Method will be provided in a Standard Operating Procedure (SOP) prior to field work initiation.

Table 7-2

LABORATORY ANALYTICAL METHODS

Parameters	Technical Method	Matrix	Brief Description of Method
Volatile Organic Compounds (VOCs) ⁽¹⁾	SW-846 ⁽²⁾ Method 8260	Soil Water	Gas chromatographic separation with mass spectrometric detection (GC/MS)
VOCs ⁽¹⁾	EPA-DW ⁽³⁾ 524.2	Drinking water	Gas chromatographic separation with mass spectrometric detection (GC/MS)
Semivolatile Organic Compounds ⁽¹⁾	SW-846 ⁽²⁾ Method 8270	Soil Water	Gas chromatographic separation with mass spectrometric detection (GC/MS)
Semivolatile Organic Compounds ⁽¹⁾	EPA-DW ⁽³⁾ 525	Drinking water	Gas chromatographic separation with mass spectrometric detection (GC/MS)
Petroleum Hydrocarbon Classification	SW-846 8015 Modified ⁽⁴⁾	Soil Water	Gas chromatographic separation with flame ionization detection (GC/FID)
Dioxins	SW-846 8290	Ash Soil	High resolution gas chromatography/high resolution mass spectrometry.
Pesticides/Polychlorinated Biphenyls (PCBs)	SW-846 Method 8080 EPA 608	Soil Water	Gas chromatographic separator with electron capture detector (GC/ECD).
Pesticides/PCBs	EPA-DW ⁽³⁾ Method 505	Drinking Water	Gas chromatographic separation with electron capture detector (GC/ECD).
Total and Dissolved priority pollutant metals ⁽¹⁾ and barium	SW-846 ⁽²⁾ 6010 and 7000 series	Soil	Spectrometric detection (ICP)
Total and Dissolved priority pollutant metals ⁽¹⁾ and barium	EPA ⁽⁵⁾ 200.7, and 200 series	Water	Atomic absorption, spectrometric detection (ICP and furnace), cold vapor (mercury).
Total and Dissolved Fe, Mn, Al, Ca, Mg, K, Na, V, Co	SW-846 ⁽²⁾ 6010	Soil	Atomic absorption, spectrometric detection (ICP flame)
Total Organic Carbon	SW-846 9060 ⁽²⁾	Soil Water	Combustion or oxidation

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Table 7-2

LABORATORY ANALYTICAL METHODS

Parameters	Technical Method	Matrix	Brief Description of Method
Gas-Range Organics (VPH-G)	ADEC modification of SW-846 Method 8015 ⁽⁸⁾	Soil Water	Gas chromatographic separation with flame ionization detector (GC/FID)
Diesel-Range Organics (DRO)	ADEC Method AK.102 ⁽⁹⁾	Soil Water	Gas chromatographic separation with flame ionization detector (GC/FID)
Chlorinated Herbicides	SW-846 Method 8150	Soil Water	Extraction, esterification, gas chromatography/electron capture detection (GC/ECD)
Alkalinity	I-2030-85 ⁽⁶⁾	Water	Titrimetric, electrometric
Total Dissolved Solids	EPA 160.1	Water	Gravimetric, dried at 180°C
Biological Oxygen demand	EPA 405.1	Water	5 days, 20°C
Atterberg Limits	ASTM D4318 ⁽⁷⁾	Soil	Liquid and plastic limits using wet and dry preparation techniques
Moisture	ASTM D2216 ⁽⁷⁾	Soil	Oven dried at 110°C
Grain Size	ASTM D421, D422 ⁽⁷⁾	Soil	Mechanical grain size analysis using sieves and hydrometer
Specific gravity	ASTM D854 ⁽⁷⁾	Soil	Volumetric flask/pycnometer
Phosphorus	EPA 365.2 ⁽⁵⁾	Soil	Colorimetric, Ascorbic acid, single reagent
Major Cations (Dissolved)	I-1472-85 ⁽⁶⁾	Water	Atomic absorption, spectrometric (ICP)
Major Anions (Dissolved)	I-2058-85 ⁽⁶⁾	Water	Ion exchange chromatographic, separation conductimetric detection (automated)
Nitrate/Nitrite	EPA 353.2 ⁽⁵⁾	Water Soil	Colorimetric, automated, cadmium reduction
Explosives Residue	SW-846 Method 8330	Water	High performance liquid chromatography

Table 7-2

LABORATORY ANALYTICAL METHODS

Parameters	Technical Method	Matrix	Brief Description of Method
Total Recoverable Petroleum Hydrocarbons	EPA 418.1	Soil Water	Infrared spectrophotometry
Sediment Toxicity Test	ASTM E 1391-90	Sediment	Bioassay on freshwater invertebrates
<p>(1) - The specific parameters for each group are listed in Attachment 1.</p> <p>(2) - Methods are contained in United States Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste". SW-846, Revision 0, September 1986.</p> <p>(3) - Methods are contained in EPA "Methods for the Determination of Organic Compounds in Drinking Water", EPA-600/4-88/039, December 1988.</p> <p>(4) - The modification to Method 8015 will be the United States Army Corps of Engineers proposed method.</p> <p>(5) - Methods are contained in EPA "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.</p> <p>(6) - Methods are contained in United States Geological Society Methods for Determination of Inorganic Substances in Water and Sediments, 1989.</p> <p>(7) - Methods are contained in American Standards for Testing Materials.</p> <p>(8) - Alaska Department of Environmental Conservation (ADEC), Modification of EPA SW-846, Method 8015, Draft Method for Determination of Gasoline Range Organics, Revision 5, February 1992, Juneau, Alaska.</p> <p>(9) - ADEC, Method AK.102, Method for Determination of Diesel-Range Organics (DRO), Revision 2, February 5, 1993, Juneau, Alaska.</p>			

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8. REDUCTION, VALIDATION, AND REPORTING

The North Pacific Division of the United States Army Corps of Engineers will be responsible for validation of the field screening methodology and SOPs, and analytical results from the project laboratory, as directed by ADCOE. Reviewers are required to follow EPA's "Functional Guidelines for Data Validation" (EPA 1988, 1991) in determining acceptability of data.

All data generated from sampling will be reviewed by comparing calibration, accuracy, and precision to the QC criteria listed in the method description. The validation procedures are generally composed of, but not limited to, the following steps:

- Verifying the correct samples were analyzed and reported in appropriate units;
- Verifying preservation and holding times;
- Verifying that initial and continuing calibrations were performed and met QC criteria;
- Verifying that contaminants were not present in the method blanks and that one blank was run every 10 samples; and
- Verifying that a duplicate and matrix spike, or matrix spike/matrix spike duplicate were run every 20 samples, and that QC criteria were met.
- Reviewing 10 percent of the raw data to verify that sample quantitation results are accurate.

In addition, 10% of existing data (i.e., coal storage yard) will be validated using the guidelines described above (Level IV).

All laboratory data calculations and reductions will be performed as described in the applicable method references. Raw data, including laboratory worksheets, notebooks, sample tracking records, instrument logs, standard and sample preparation logs, calibration data, and associated QC records, should be retained by the laboratory for a minimum of 10 years and be

available for inspection if necessary. While the laboratory data management system may store records on magnetic files, provision should be made for hard copies as necessary to validate results.

At a minimum, laboratory reports should contain the project title and identification number; name and date of report; analytical method used; name, address, and telephone number of laboratory; sample identification number and matrix; and any comments that may be relevant for interpretation of data. Minimum data reporting requirements set forth in ER1110-1-253 will be met. The report should be signed by the laboratory manager or QA manager.

The data for each parameter analyzed will be recorded, including the parameter name, analytical result with detection limit, units associated with the results, and reference to the analytical method employed. In addition, results of associated QC analyses, including laboratory method blanks, spike recoveries, and duplicate samples, will be submitted with each report.

The analytical report will be available to ADCOE, both in hard copy and electronic copy, 90 days following laboratory receipt of the final sample shipment.

9. INTERNAL QUALITY CONTROL CHECKS

QC data are necessary to determine precision and accuracy and to demonstrate the absence of interference and/or contamination of sampling equipment glassware and reagents, etc. Specific QC requirements for laboratory analyses will be the responsibility of the project laboratory.

Field QC will include the following:

- **Field Blanks** are blank samples prepared in the field by pouring organic-free reagent grade water into sample containers at the sample collection site. They are used to determine if contaminants were introduced from ambient conditions during sample collection and are analyzed for volatile organic compounds (VOCs). Field blanks will be included with water samples designated for VOC analysis at a rate of one per day or one per sampling location, whichever is greater.
- **Trip Blanks** are blank samples prepared to assess ambient transport conditions. They will be prepared by filling empty sample containers with deionized/carbon-free water and any necessary preservatives. The blanks will be handled like a sample and shipped to the laboratory for VOC analysis. Trip blanks will be collected for water and soil samples designated for VOC analysis only at a rate of one per shipment.
- **Field Equipment Rinsate Blanks** are blank samples (sometimes called transfer blanks or rinsate blanks) designed to demonstrate that sampling equipment has been properly prepared and cleaned before field use, and that cleaning procedures between samples are sufficient to minimize cross contamination. Rinsate blanks will be collected at a rate of one blank per day for each type of sampling activity (surface soils, soil borings, groundwater samples). They will be analyzed for VOCs, semivolatile organic compounds, petroleum hydrocarbon classification, Total Recoverable Petroleum Hydrocarbons (TRPH), pesticides/polychlorinated biphenyls (PCBs), dioxin, target analyte metals, and total priority pollutant metals.
- **Field Duplicate** samples consist of a set of two collocated samples collected independently at a sampling location during a single sampling event. The field duplicate will be a blind duplicate (i.e., indistinguishable from other analytical samples) so that personnel performing the analyses are not able to determine